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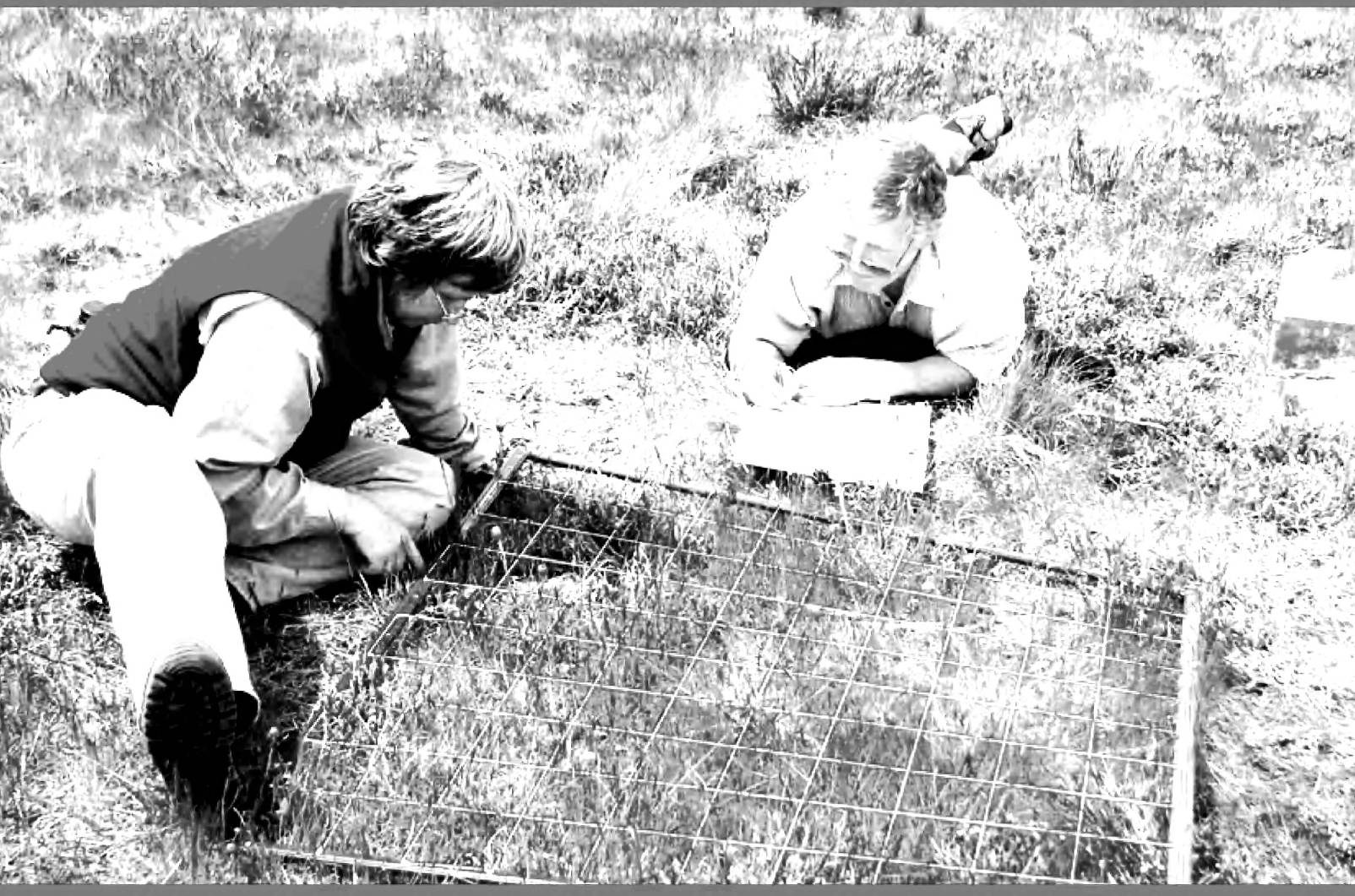

Topsoil translocation: an effective method for increasing plant species diversity in restored sites

Biodiversity Monitoring: Branching 'outside the Box' for Box-Gum Grassy Woodland

Plant monitoring and building community stewardship of local endemics

Restoration as a learning process – lessons from temperate grasslands

Adaptive monitoring of vegetation in the Macquarie Marshes, New South Wales

Measuring success in endangered species habitat management, the Brickpit, Sydney Olympic Park 2006-2011

And much much more …

SPECIAL THEME: MONITORING AND PLANT CONSERVATION

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Contributing to *Australasian Plant Conservation*

Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. **The deadline for the March–May 2012 issue is Friday 24 February 2012.** The theme for the issue is **Best practice methods for monitoring and plant surveys.** Specific examples of effective monitoring and general articles are also very welcome. Please contact Selga Harrington if you are intending to submit an article: selga.harrington@gmail.com.

Authors are encouraged to submit images with articles or information. Please submit images as clear prints, slides, drawings, or in electronic format. Electronic images need to be at least 300 dpi resolution, submitted in at least the size that they are to be published, in tif, jpg or gif format. Guidelines for authors are at: http://www.anpc.asn.au/anpc/pdffiles/APCGuideContrib.pdf.

Please send articles, no more than 1200 words, as a MS Word file (2000 compatible) by email to: selga.harrington@gmail.com.

Front cover: Royal Tasmanian Botanical Gardens staff, Alan Macfadyen and Natalie Tapson carrying out a quadrat survey in the grassland area of a cemetery Photo: Chris Lang.

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Contents

From the editor 2

President's report *by Bob Makinson* 2

Request for feedback on monitoring programs *by Thomas Payne* 3

Restoration as a learning process – lessons from temperate grasslands *by David Freudenberger and Paul Gibson-Roy* 4

ACT and region community-based biodiversity vegetation monitoring *by Sarah Sharp, Debbie Saunders and Andy Westcott* 6

Serendipity during long-term monitoring of translocation trials *by Manfred Jusaitis* 8

Monitoring the endangered Tumut Grevillea (*Grevillea wilkinsonii* R.O. Makinson) *by Nicki Taws* 10

Plant monitoring and building community stewardship of local endemics *by Lorelle Campbell* 12

Monitoring remnant native grassland at St. Lukes Cemetery, Bothwell, Tasmania *by Chris Lang and Natalie Tapson* 14

Topsoil translocation: an effective method for increasing plant species diversity in restored sites *by Mark Tozer, Christopher C. Simpson, Berin D.E. Mackenzie and Mark Blanche* 16

Adaptive monitoring of vegetation in the Macquarie Marshes, New South Wales *by Darren Shelly* 18

Measuring success in endangered species habitat management, the Brickpit, Sydney Olympic Park 2006-2011 *by Jennifer O'Meara and Andrew Jack* 20

Biodiversity Monitoring: Branching 'outside the Box' for Box-Gum Grassy Woodland *by Mary Munro and Damien Michael* 22

Australian Plant Census: November 2011 update *by Brendan Lepschi and Anna Monro* 25

Regular Features

ANPC in the USA: directions in science and conservation at the Smithsonian Institution 26

Report from New Zealand Plant Conservation Network 28

Book Reviews 28

Information Resources and Useful Websites 30

Research Roundup 31

Conferences and Workshops 32

From the editor

Selga Harrington

Parsons Brinckerhoff

Welcome, readers, to 2012 and the summer issue of Australian Plant Conservation. The theme for this issue is '*Monitoring and plant conservation*'. Monitoring is an important aspect of plant conservation work, providing data to assess changes over time and allowing people to make informed decisions about management practices, and make changes to those practices if necessary.

This issue includes specific examples of monitoring on-ground plant conservation activities, ranging from monitoring:

- threatened species, including Tumut Grevillea (NSW), Lanky Buttons (Tas) and Byfield Matchstick (Qld)
- vegetation communities and the habitats they provide, including temperate grasslands and grassy woodlands
- threatened species habitat management, including weed control within the Sydney Olympic Park brickpit which provides habitat for the Green and Golden Bell Frog
- the effectiveness of restoration activities including destocking in the Macquarie Marshes and revegetation using topsoil translocation.

Included in this issue is a request from the NSW Central West Catchment Management Authority for feedback on community based monitoring programs and how to get landholder volunteers involved in monitoring. A subject I'm sure a lot of our readers have experience with.

The themed articles are followed by an update on Australian Plant Census, a project that aims at providing an up-to-date list of accepted names for the Australian vascular plants, both native and introduced. An invaluable tool to help us all to stay on top of the name changes!

This issue also includes the (outgoing) ANPC President's report from Bob Makinson who has provided strong leadership to ANPC for the last three years. The issue concludes with our regular features: Zoë Smith's final report from the USA, Report from New Zealand Plant Conservation Network; two book reviews, Information Resources and Useful Websites, Research Roundup and upcoming conferences and workshops.

Enjoy your summer reading!

President's report

Bob Makinson

From the (outgoing) President

2011 has marked the 20th year of the Australian Network for Plant Conservation, but we're holding the party over for a big 21st celebration at our national conference next year (in Canberra, 30 Oct. to 2 Nov. 2012 – save the date!).

20 years is a long time for any non-government organisation, and for the conservation cause. We have seen high- and ebb tides of government policy on biodiversity conservation, the adoption of some good legislation (and some not so good), and ebbs and flows in the level of government funding for both conservation research and for non-government practitioners. There has been a consistently high level of public support for conservation despite governmental wavering, a steady growth in private conservation initiatives, the survival of important strategic gains like the Landcare and Bushcare movements, and a vast expansion in knowledge of our biodiversity.

Yet the threats to native biodiversity and systems continue, and while as a nation we have gone forward in capacity, we have overall gone backwards in the level of decline of our natural heritage. In the next two decades we have realise on the capacity, if we are to arrest and reverse the decline.

ANPC's role over these 20 years, in providing linkage and expertise transfer, has been an 'under the radar' contribution, but an important one for our size.

We have shown a capacity to anticipate and act on needs for scientifically sound techniques before they have come into vogue - the two iterations each of our Translocation Guidelines and Germplasm Guidelines, each prepared by voluntary expert teams, were national needs not being met by any government agency or by the bigger NGOs.

We have consistently offered workshops and courses focussed on bringing the latest and best scientific knowledge to end-users, and on providing a forum for the practical knowledge of those users themselves.

And of fundamental importance, at our conferences and in our courses we have provided regular points of dialogue and knowledge-exchange between sectors that rarely get to sit down together – practitioners, managers, policy people, and researchers.

It's a pretty good 20-year record for an organisation that has never had more than four part-time (and usually two) paid staff. It's all down to our members and supporters and their voluntary contributions of time, energy, and expertise. Among them are our corporate members – many of the major botanic gardens and herbaria and conservation agencies have given staff-time and other forms of support for our work. In particular, the Australian National Botanic Gardens has hosted our national office since 1991 – a great and direct contribution to the national conservation effort.

2011 has been a very active year for ANPC. We have been the first (and so far only national) organisation to roll out publicly accessible training events on the newly arrived Myrtle Rust pathogen that threatens so many wild and cultivated species. We held three training events on management of native vegetation in Travelling Stock Reserves (TSRs), funded by the NSW Environmental Trust. We have also developed a partnership with the national Meat Industry Training Advisory Council (MINTRAC) to extend our capacity to deliver courses, and which we hope will help us return to offering TAFE-accredited events in the future.

For 2012, in addition to further TSR and Myrtle Rust courses, and the national conference, we are hoping (the little gods of funding permitting) to fully translate the ANPC Germplasm Guidelines into training modules, develop a new series of plant identification courses, and take the Myrtle Rust course to all States.

In 2012, ANPC can help you stay in touch with developments in plant conservation through this quarterly bulletin, which is also an avenue for you to publish your work and experience to a wide conservation readership. On a more frequent basis you can stay in touch via our e-bulletin ANPC News (an opt-in free subscription – visit http://anpcnews.blogspot.com/ to sign up), which is also an opportunity for you to post short news items about developments in your State or Territory.

On a personal note, I reach my constitutional use-by date as President of ANPC at the 2011 Annual General Meeting. During my tenure, and in my time on the Committee before that, it has been a privilege and a pleasure to work with many remarkable and dedicated ANPC members and staff. There are far too many to mention individually but I'd like to say particular thanks to staffers Sally Stephens, Merryl Bradley, and Sue Mathams, and to past Committee members Phil Ainsley, who has been a rock-steady Secretary of ANPC in recent years, Tricia Hogbin and Judy West who helped steer ANPC through difficult times, Jim Crennan, Cathy Offord, Rosemary Purdie, Helena Mills … and many, many others.

Finally – if you're reading this but haven't joined ANPC yet, or have not renewed your membership for a year or two, or are looking for a tax-deductible gift recipient – now is the time. We are making a difference, and we need you as a member and supporter. It's just a click away.

Bob Makinson
(ANPC President 2008-11)

Request for feedback on monitoring programs

Thomas Payne

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I had the privilege of speaking recently at the 'Reading the Landscape' conference on biodiversity held in Dubbo, NSW. I was a panel member in a session aimed at provoking discussion amongst participants (research ecologists, representatives of state and federal natural resource management agencies, and private landholders) on issues related to conservation of flora and fauna in the Central West Slopes. One topic from the conference that has generated some interest is a proposed program to encourage private landholders to report wildlife sightings within the Central West Catchment.

The Central West Catchment Management Authority (CMA) oversees the catchments of the Bogan, Castlereagh, and Macquarie rivers, and comprises a landscape that has been highly modified since European colonisation. Land clearing and grazing practices, changed fire regimes, and the introduction of exotic plant and animal species have all contributed to a decline in native biodiversity. Stands of native vegetation on privately held land generally persist as relatively small fragments. Vegetation communities that require soil types and landscape situations also suited to agriculture are under-represented across the Central West.

As a Catchment Officer charged with implementing incentive programs that encourage environmentally sound land management practices, I frequently attend meetings of Landcare and other local landholder community groups. In conversations arising at these meetings I have been struck by the enthusiasm many landholders have for the

wildlife present on their properties, and by the extent of their knowledge of such things as seasonal behaviour or favoured habitat. It seems logical that people running farm businesses requiring an understanding of animal husbandry or basic plant physiology, and who live in close proximity to nature, should be astute and intuitive ecological informants.

The idea of recruiting landholder volunteers to partner with our CMA in monitoring the state of biodiversity across the Central West is at present little more than a topic of discussion that may or may not develop into a fully-fledged program in the 2012-13 financial year. But it is a discussion that we would like the readers of APC to join.

Questions we would put to ecological researchers and natural resource managers (that is, the end users of monitoring information submitted by the landholder community) are:

- What are your experiences with community-based monitoring programs?
- What is the minimum amount of data necessary to make a record of a species sighting useful to you?
- What level of verification would you need in order to consider such data reliable?
- Where a record for a plant is made, would you consider it necessary for a voucher specimen to be submitted to a herbarium, or would photographic evidence or informed observation suffice?

We often hear landholders describe themselves as being time poor. Therefore, many of our questions for potential volunteer naturalists relate to factors that would limit their participation:

- What would motivate you to share your observations with the CMA?
- How much time would you be willing to devote to reporting on biodiversity in your patch?
- And related to the above, how often would you be willing to submit observations?
- If the CMA held free trainings or organised meetings in your area where volunteers could compare notes and learn about local biodiversity issues, natural history, threatened species, conservation efforts, etc., would you be likely to attend?

Readers can contact me directly to share their ideas, insights and experiences. Please phone (02) 6847 8501 or e-mail thomas.payne@cma.nsw.gov.au.

Restoration as a learning process – lessons from temperate grasslands

David Freudenberger and Paul Gibson-Roy
Greening Australia

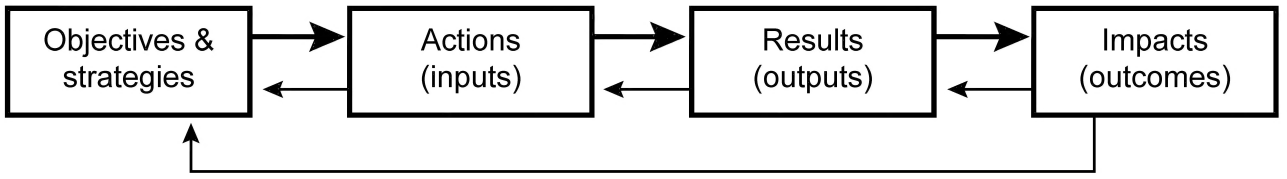
Summary

To date the Grassy Groundcover Research Project (GGRP) has restored nearly 40 ha of species-rich grassland. Put into context, virtually no remaining high quality grassland sites in western Victoria are larger than 1 ha in size. With GGRP methods producing 50 plants per m^2, over 20 million plants (representing over two hundred species) are now contained therein. Monitoring and learning were important elements of GGRP that led to this significant outcome.

Restoring herb rich grassy ecosystems

Greening Australia's development of strategies and technologies to restore diverse native temperate grassland and grassy woodlands (with hundreds of species) is a useful illustration of how monitoring and review can play a critical role in improving restoration outcomes (Gibson-Roy et al., 2010). Initiated in 2004, a fundamental element in the success of GGRP was a commitment by management and staff to a simple and clear objective: increase the spatial scale and diversity of temperate grassland restoration. This was coupled with an effective and productive Research and Development (R&D) partnership with the University of Melbourne that was supported by various funding bodies (government agencies, corporations and individual donors) over many years.

Throughout this period the GGRP has benefited from a team of talented staff with a range of research and on-ground skills. All have been dedicated to developing novel and effective restoration approaches through a process of continuous learning and improvement, which has been supported by embedding monitoring processes across the program. Specialist researchers were integral to developing, investigating and interpreting experimental actions. Just as important, it involved simple monitoring and review strategies at all levels of the program including steering committees, technical panels and ongoing staff-led program reviews. Critical contributions were made by non-specialists in areas such as site management, seed collection, plant propagation, seed production and seed sowing. These combined skills ensured the GGRP was able to prosecute a particularly difficult restoration challenge.



A framework that identifies the multiple points at which monitoring is needed to improve restoration practices and outcomes. The thick arrows indicate the consequences of implementation and the thin arrows indicate key interpretation and learning feedback loops (from Freudenberger 2011).

The other component of monitoring that was utilised in this R&D process was the rigorous recording of inputs or actions. This included critical data such as what species, from which location, from how many plants, used in what seed production setting, producing how much seed, with what purity characteristics, sown on what date, at what rates, and on ground prepared by what method. Assembling this broad range of detailed input data allowed far more rigorous scrutiny of field outcomes such as 'why did this species fail or succeed', rather than attributing results solely to readily apparent factors such as rainfall or temperature.

Many years after setting clear objectives, the GGRP continues to review actions and monitor outcomes. Vegetation development and resilience are examined in detail, while formal monitoring of native insect, reptile and bird species that are colonising the restored grasslands has begun. Indeed, to determine the success of these methods it is critical to know what species have persisted, what species are increasing in range, and which ones have disappeared or are declining. We are learning about which species or assemblages are favoured by wet and dry years, and at what points (if any) prescribed burns, or other means of biomass reduction, are required.

The monitoring and review based approach adopted by the GGRP has contributed to achieving its initial goal. It has also increased the body of information such as newsletters and papers that are available to the restoration sector (Grassy Gazette - http://www.greeningaustralia.org.au/index.php?nodeId=90, Gibson-Roy 2010).

Lessons learned

Restoring Australia's extraordinary diversity of plants, at the scale of hundreds and thousands of hectares, is a national imperative. Anything less would mean too many species could effectively go extinct. Species in seed vaults and botanical gardens, while important, are not living and evolving systems. Conversely, there are no proven 'recipes' available to restore hundreds of species across thousands of hectares of degraded land. Restoration is not wheat farming – it is far more complex. There is not the seed, sowing technology, nor experience to restore whole communities at scale with the confidence of a wheat farmer. Therefore, 'learning by doing' based on monitoring and review are critical elements when attempting large scale restoration, especially when the objective is restoration of rich plant diversity such as that found in temperate grasslands.

Developing cost-effective restoration approaches and technologies is a tough challenge. In Australia a lack of funding for complex restoration programs and the limited development of restoration infrastructure and technology has severely limited progress. In addition, short term funding exacerbates high staff turnover that compromises long-term monitoring and review needed to underpin improvement of restoration methods and outcomes.

Projects like the GGRP show that effective monitoring benefits from clear objectives and goals, such as the goal to improve restoration practices and outcomes. The fundamental question is: 'if a restoration practice is changed, is there then a desired outcome?' We've found that a simple framework can be useful for designing an effective monitoring program. Too often monitoring starts at the wrong end of this sequence. There is a common desire to monitor restoration outcomes. Fine, but first monitor (record) the objectives of a restoration project, state the strategies the project adopted, carefully record the actions implemented (who did what on the day), rigorously monitor the results of those actions (e.g. dead or alive plants), then a few and/or many years later, assess the ecological outcomes (e.g. resilient communities or viable populations of threatened species).

Monitoring starts with an enquiring mind and a passion for learning and can be as sophisticated as these automated soil moisture probes and data loggers used by the Grassy Ground Cover Research Project. Photo: P. Gibson-Roy.

Ecological restoration is a journey of discovery, learning and improvement that should travel on a foundation of thousands of hours of monitoring in various forms and at multiple scales; from test tubes in the lab, to hundreds of quadrats across dozens of field sites separated by hundreds of kilometers. Ecological restoration is a journey that requires passion, enthusiasm, persistence, and collaboration amongst researchers, onground staff, landholders, volunteers, funders and donors. While it can often be a challenge to remain focused and committed to the various aspects of monitoring and review, it is essential for successful restoration.

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Small scale research plots were an important tool in developing large scale restoration of highly diverse temperate grasslands and grassy woodlands. Photo: P. Gibson-Roy

ACT and region community-based biodiversity vegetation monitoring

Sarah Sharp[1†], Debbie Saunders and Andy Westcott[2]

[1] Natural resource conservation consultant [†]Corresponding email: sarahsharp@grapevine.net.au; [2] Molonglo Catchment Group

A Step-by-step Guide to Monitoring Native Vegetation in the ACT is a manual written by Sarah Sharp and Lori Gould, published in 2010, under a grant from the National Heritage Trust. The vision behind the publication was to provide the necessary skills for community groups to undertake simple vegetation monitoring and survey that is directly relevant to their needs while also providing meaningful long-term information about different sites across the region.

The manual was designed with four aims:

1. To gather vegetation and environmental data with relevance to ecosystem conservation and management, with an emphasis on practical application.
2. To provide the tools to assess whether on-ground actions are achieving the desired outcomes, so that management and resources can be better targeted towards improving biodiversity.
3. To enable useful, scientific and comparable monitoring of vegetation to be carried out using practical field-based, assessment methods.
4. To encourage and support a range of people in gaining the skills to assess environmental condition, and in doing so, develop their understanding of the natural processes occurring within their sites.

The manual was adapted from several existing publications and methods, most particularly *The Bushland Conservation Monitoring Manual* produced by the Nature Conservation Society of South Australia (Croft et al., 2005). We acknowledge with much appreciation their permission to adapt their material for our manual. The measurements are also consistent with national standards for measuring vegetation set out in the *Australian Soil and Lands Survey Field Handbook* (Hnatiuk et al., 2009).

The manual provides a guide to mapping a site and surveying and/or monitoring a range of condition indicators. The information provided in the manual helps to choose the most appropriate indicators to measure, depending on what the user wants to find out about their site. The user may decide to do all measurements, or choose only a selection, based on their needs.

The steps that the user is taken through are:

1. Deciding what to do: is the activity to map and describe an area; is it to survey vegetation condition and other site attributes or is it to monitor the condition, or some aspects of condition, of the vegetation and the site attributes?
2. Undertaking a survey: how to map a site and vegetation units within the site and how to describe the features and how to survey the vegetation. The methods of surveying the vegetation can be changed to allow for different levels of skills of the user.
3. Preparing for monitoring and assessment of condition: involves planning for the monitoring – identifying what the aims of the management are to help determine what will be monitored, choosing the appropriate indicators for monitoring, allocating where the monitoring will take place, who will be involved, what it will cost, who should be consulted to get further advice on the study design.
4. Measuring the indicators and interpreting the results: Each of the eight indicators is described in detail, with examples, and blank recording sheets are provided. A section on each indicator describes how to interpret the results.

Each section on the indicators describes in detail why each one is undertaken, how it is undertaken, what materials are required, and provides examples of what information is collected. Appendices include a guide to useful references, a glossary, a copy of the *ACT Flora Checklist* (Lepschi et al., 2008), a list of the pest plants of the ACT and a list of threatened species and communities in the ACT and region.

To date, over 90 people have been trained in using the Manual. Participants came from a wide diversity of interests and backgrounds including members of community groups such as Parkcare, Friends of Grasslands, Conservation Council, Greening Australia staff and volunteers, along with ACT and NSW government environmental officers, rangers, and landholders (including hobby and full-time farmers). The techniques in the manual were taught at two NSW workshops in 2010 run by the Australian Network for Plant Conservation for community groups and government officers involved in management of Travelling Stock Reserves and other off-reserve conservation areas.

Training session in using the Monitoring Manual. Photo: J. Geue

In 2010 the Molonglo Catchment Group, with support from an ACT Environment Grant, undertook a program to train five small landholders and review the results to determine whether the Manual could be used successfully to encourage community monitoring using a single system to provide consistent, robust but simple results. A review of the data collected by the five landholders was undertaken (Rehwinkel 2011). The Manual is currently being revised, taking this feedback into consideration.

The Molonglo Catchment Group is using the Manual as the basis for running a community-based biodiversity monitoring project. The project aims to encourage the application of comparable monitoring of vegetation and habitat condition across the region. The project is being implemented with assistance from the Australian Government's Caring for our Country program and the ACT Government and is also supported by the Ginninderra Catchment Group, Southern ACT Catchment Group and ACT Parks and Conservation Service.

The project involves undertaking training sessions and implementing on-ground monitoring at eight sites. The initial planning days aim to help community groups develop goals and plans for their sites, decide what type of monitoring they need to do to determine if those goals are being met and how to make the most of the information gathered using the Manual. The field training days aim to provide practical field experience in using the monitoring techniques from the Manual. The monitoring days aim to provide on-site expert support for each group when they begin their monitoring program to ensure group members are comfortable and confident when implementing their chosen monitoring techniques. The data will be used by community groups to guide their on-ground efforts and to learn from each other by comparing results over time and in different locations to improve the best practice management for their sites. An online database developed by Molonglo Catchment Group will assist with easy online data entry and mapping making the results readily available to community groups.

At the ACT and Region level the project aims to provide consistent baseline data across sites enabling the effectiveness of techniques to be evaluated at different locations, and to identify potential linkages between biodiversity hot spots, threatened species habitats and weeds of significance. It will also assist community groups and other land managers to determine what the funding priorities will be for future works.

Monitoring at Aranda Bushland, ACT. Photo: P. Keene

CD copies of the Manual are available for free from Sarah Sharp or Lori Green at Greening Australia Capital Region.

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Serendipity during long-term monitoring of translocation trials

Manfred Jusaitis

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Introduction

An essential component of all translocation projects is the monitoring of outcomes and evaluation of processes after planting has taken place. Monitoring goals and objectives are usually formulated early in the translocation planning process based on available knowledge of the species' biology and ecology. However, nature is rarely predictable, and occasionally unexpected and even surprising observations can be made during the course of long-term monitoring that may be missed altogether in the short-term. Such serendipitous observations may be readily explainable, or may lead to further experimentation or extended monitoring in order to understand their underlying mechanisms. I have experienced several examples of such serendipity in the course of long-term monitoring of translocation trials in South Australia, and will briefly discuss four of them here. None of these outcomes were predicted to occur in the way they did when the translocation trials were first planned or set up, and each one was revealed only after a significant period of consistent and regular monitoring.

Brachyscome muelleri

The annual herb, Corunna daisy (*Brachyscome muelleri*) was introduced to a new site 1.5 km from its natural population in 1997. Early monitoring showed an abundance of seedlings emerged in their first season, fewer seedlings were found during the subsequent 2 years, and numbers swelled again in the fourth year. This observed pattern of recruitment correlated well with annual rainfall (Jusaitis et al. 2004). Subsequent annual monitoring revealed a regular cyclical pattern of recruitment with a period of 3-4 years. In each year immediately following a peak, seedling numbers fell dramatically. This longer-term cycle no longer correlates with annual rainfall, and is postulated to possibly involve dormancy-cycling phenomena in the seed. A similar synchronised recruitment pattern was observed concurrently in the natural population. This cyclic trend became evident after at least 10-15 years of observation. Ongoing monitoring will be required to confirm its repeatability and to understand its underlying mechanisms.

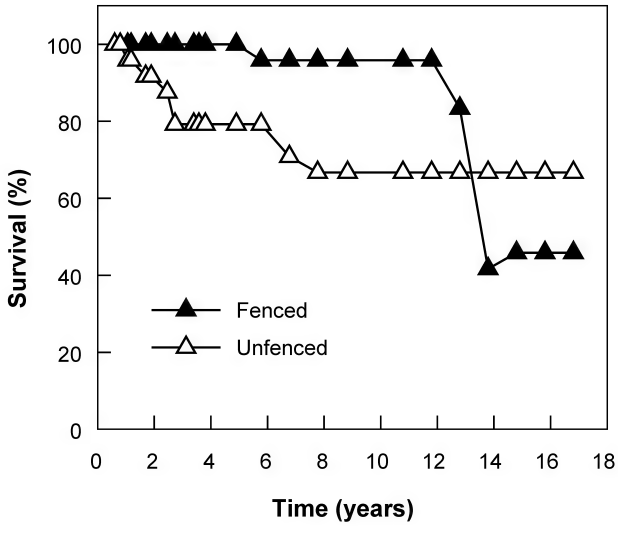
Haloragis eyreana

Prickly raspwort (*Haloragis eyreana*) illustrates the serendipitous discovery of an ideal microsite for translocation. The goal of this study was to examine the influence of planting-site proximity to the water table on translocation success by constructing a series of high and low crests separated by trenches. Plants were transplanted onto high and low crests to compare survival and recruitment in relation to distance from the water table. Survival was slightly higher on low crests, but the number of surviving translocants on both high and low crests declined steadily over 4 years, when none remained (Jusaitis & Freebairn 2010).

However, in year 3 a few seedling regenerants were noticed along the bottom of the trenches, and over the next 6 years the number of plants observed in trenches increased exponentially to average 18 plants/m^2 by year 8. Trench plants were more likely to perenniate from year to year than crest plants. Trenches had consistently higher moisture levels and tended to have fewer weeds than crests, providing a suitable protected microsite to support successful germination and proliferation of *H. eyreana*.

Prostanthera eurybioides

Monarto mintbush (*Prostanthera eurybioides*) illustrates an intriguing interaction of climate with herbivory. A translocation trial was set up to study the impact of herbivores on establishment (Jusaitis 2010). Seedlings were planted into replicated, paired, fenced and unfenced plots. Frequent grazing damage was observed on unfenced plants over 17 years of monitoring, although this rarely proved fatal once plants were established. By year 7, survival had stabilized at 96% (fenced) and 67% (unfenced), remaining at those levels for the next 4 years. In 2006 (year 11), the translocation site experienced its lowest rainfall on record, followed by 2 years of below average rainfall. This severe drought resulted in a dramatic loss of fenced plants, while having no effect on survival of unfenced plants.



Survival of Prostanthera eurybioides *translocants in fenced and unfenced plots over 17 years. The decline in the fenced population was related to a drought event, while the steady population in fenced population suggests that grazing may assist the plant to withstand severe periods of drought.*

The explanation for this unforeseen phenomenon lay in the size of unfenced plants which, due to frequent grazing, were about one third the size of fenced (ungrazed) plants. The larger size of the latter meant a larger leaf surface area, higher transpiration losses and thus increased susceptibility to water stress, compared with the smaller, unfenced, grazed plants which survived the drought. Thus, although it was tempting to abandon monitoring after the population had been stable for 5 years, the next 5 years revealed an unexpected result which suggests that this plant is far more tolerant of grazing than was first thought. Indeed, grazing may assist the plant to withstand severe periods of drought. Interestingly, the first significant recruitment of new seedlings was observed in year 14, so the drought may also have played a role in overcoming seed dormancy (Ainsley et al. 2008).

Phebalium glandulosum

The desert Phebalium (*Phebalium glandulosum* ssp. *macrocalyx*) was translocated to a protected sanctuary to establish a secure population. A success indicator of this study was to document survival, flowering, reproduction and recruitment of the species. Survival stabilized after 3 years and survivors continued to grow over 20 years of monitoring. Flower buds were first seen on plants a year after planting, and subsequently plants flowered and set seed annually. Eleven years into the trial, the average percentage of flowers that set seed was similar in both translocated and wild populations.

The first recruitment of new individuals was observed 18 years after translocation. Most were at the 2-leaf stage, but a few larger seedlings were also found that may have emerged a year or two earlier. More new recruits were found the following year. Thus the full cycle of establishment, flowering, reproduction and recruitment took at least 16 years for these translocants. Recruitment did not require a disturbance event, and most seedlings were found clustered around the base of parent plants where shade and moisture retention provided a protected germination niche.

Conclusions

I hope that these brief cameos portray the importance of a long-term view when monitoring translocation trials. Each discovery made here would have been missed had monitoring ceased within the time frame of 4 years, an apparent standard for most documented translocation projects (Godefroid et al. 2011). As well as evaluating the success or failure of the translocation project, consistent long-term monitoring can also generate unexpected and surprising results that can deepen our understanding of the species and its ecology.

Acknowledgements

I would like to gratefully acknowledge Anthony Freebairn for assistance with the concept and construction of the *Haloragis eyreana* trial, Graham and Brenton French for allowing access to the Corunna pastoral property, and the Australian Wildlife Conservancy for allowing access to Yookamurra Sanctuary.

First seedling recruits of Phebalium glandulosum *observed 18 years after translocation. Photo: Manfred Jusaitis.*

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Monitoring the endangered Tumut Grevillea (*Grevillea wilkinsonii* R.O. Makinson)

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Introduction

The Tumut Grevillea, *Grevillea wilkinsonii*, is found only along a 20 km length of the Goobarragandra River near Tumut, NSW, and in one small population of seven individuals near Gundagai (NPWS 2001). This species is currently listed as Endangered on both the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the NSW *Threatened Species Conservation Act 1995*.

The species was discovered in 1982 by local naturalist, Mr Tom Wilkinson, and only formally named and described in 1993. Only two sites were known initially, one on public land (Travelling Stock Reserve (TSR) and the other on private property c. 3.5 km downstream. Between these sites, all river frontages (apart from 150 m of National Park) were privately owned. It was clear that to undertake any survey work, develop recovery actions or conduct ongoing monitoring of the Tumut Grevillea, gaining the interest and cooperation of private landholders was essential.

Early recovery activities for this species included fencing part of the TSR containing *G. wilkinsonii*, taking cuttings from plants at both known sites, and re-introducing propagated plants near the first site and at a picnic area a short distance upstream (NSW NPWS 2001).

The initial survey

An initial survey to measure the size and age structure of the natural population was undertaken in 1993. Landholders were contacted initially by telephone, then visited in person to seek permission to look for the Grevillea. The survey covered 27 km of the Goobarragandra River (plus other tributaries) however, the Tumut Grevillea was only found along a 4.5 km stretch of the river. All but one of the landholders cooperated in allowing access to survey the

river banks. At a public meeting of 30 landholders in 1993, thirteen indicated interest in having plantings of Tumut Grevillea reintroduced onto their land.

From this first survey the population of Tumut Grevillea was estimated at 620, of which only about 25% were classed as adult, that is, greater than 1 m tall and with evidence of reproductivity. Threats to the species included flooding, stock browsing, fire, and competition from weeds and dense native shrub growth.

Five-year monitoring

The original population was re-surveyed in 1998, this time with access to all private properties. All plants were recorded, mapped and photo points established at 13 separate colonies. Each plant was classed into one of three size categories; seedling (0.1-0.2 m), mid-sized (0.2-1.0 m) or adult (>1 m). Size was considered to be more important than age when classifying plants because those under 1 m tend to have few flowers, regardless of age. A total of 644 plants were counted, 46% of which were in the adult class. The planted specimens were also surveyed. These showed high survival rates but no seedlings were found to have recruited from these plants. The main impacts noted on the population in the five years since the initial survey were browsing damage by stock, and competition from vigorous native shrub growth and introduced weeds.

Fifteen-year monitoring

A third survey of the population was carried out in 2008 taking in an additional small colony which had been located in the intervening 10 years, 5 km downstream of the main distribution. The full 11 km length of the river between the upstream and downstream colonies was surveyed to investigate known colonies and to check for new ones. Four small new colonies were located within the original range. In order to determine the contribution of reintroduced plantings, colonies established between 1993 and 2006 at three sites within the natural distribution of the species were also monitored.

In 2008 the total number of Tumut Grevillea in the natural colonies was 514 with a size structure ratio of 19:25:56 percent (seedling : mid-sized : adults). This represented a decline of 130 plants from 1998. Most of the reduction occurred in the mid-sized class. However, at the reintroduced planting sites, a total of 251 plants were counted and mapped. The size structure ratio of 13:49:38 percent revealed that recruitment from these propagated plants had occurred. With the addition of 40 plants found at the four new sites, the total Tumut Grevillea population (encompassing 20 colonies) stood at 805.

Floods

Between September and December 2010 a series of major floods were experienced along the Goobarragandra River, causing stream bank erosion and damage to riparian vegetation within the distribution of the Tumut Grevillea.

The Endangered Tumut Grevillea, Grevillea wilkinsonii. *Photo: Bindi Vanzella*

In early 2011 a survey was undertaken to assess the extent of flood damage to the Grevillea population.

Results from the survey found a total of 900 Tumut Grevillea in 19 colonies (one colony consisting of a single large plant could not be found). This was an increase of 12% on the 2008 total. Numbers within the original natural colonies had declined from 644 plants in 1998 to 514 in 2008 and then to 399 in 2011. This 22% reduction in population size between the 2008 and 2011 survey is likely to be attributable to the 2010 floods. The greatest impact of flooding was noted in the sub-adult group, with 35% fewer mid-size plants and 48% fewer seedlings.

Despite the magnitude of the floods, monitoring revealed that adult plants seemed resilient to flood disturbance, with only an 8% reduction in numbers. Most of this loss occurred at a single site, while declines at other sites seemed attributable to other factors such as inadvertent herbicide spraying. Many adult plants were noted to have been damaged by the battering of floodwaters or from being smothered with flood debris, however, most showed signs of recovery through re-sprouting from branches or from the base of canopies. Based on observations from the post-flood survey, disturbances such as those experienced in 2010 pose a sporadic threat to the Tumut Grevillea, and are more likely to impact on sub-adult plants in the population. Despite this, floods may also create new opportunities for recruitment by removing competing vegetation, creating bare earth and depositing sand and soil. Continued monitoring of these sites will be important to determine when recruitment occurs in the natural colonies or at new locations within the riparian range of the species.

On-going monitoring of the Tumut Grevillea along the Goobarragandra River has been essential in assessing its range and the development. It has also revealed that the overall increase in population size between 2008 and 2011 (from 805 to 900 plants) was the result of recruitment occurring predominately within the three reintroduced planting sites. This suggests that the establishment of new colonies of Tumut Grevillea by tubestock plantings is one means of promoting the conservation of this species.

Acknowledgments

Funding for the various surveys over the years has been provided by the Federal Envionment Department Endangered Species Program (1993, 1998), the NSW Department of Environment, Climate Change and Water (2008) and NSW Office of Environment and Heritage (2011). Bob Makinson (RBGSyd) and John Briggs (OEH) have been instrumental in organising surveys, and staff of NSW OEH, particularly David Hunter and Genevieve Wright have assisted with the surveys. Property owners who granted access to undertake these surveys are gratefully acknowledged.

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Plant monitoring and building community stewardship of local endemics

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In 2012, *Comesperma oblongatum*, the Byfield Matchstick, listed as Vulnerable, will feature on a pictorial calendar of local ecological events on the central Queensland coast. *Commersonia perkinsiana* will be given the status of Endangered by the Queensland Government and is likely to evolve a common name locally. The severely eroded 4WD tracks through their core habitat will be rehabilitated to walking tracks with interpretive signage about these locally endemic plants, and the land managers will monitor and manage the plants.

In 2008, *Commersonia perkinsiana*, was only known to the discoverer, Joel Plumb and the describer Gordon Guymer (2006). It was not on any lists or plans and not known to the land managers where it occurred. *Comesperma oblongatum,* listed as Vulnerable, was mentioned in lists and plans with a conservation advice statement on the Australian Government's Biodiversity Species Profile and Threats Database website (http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl). However, the on-ground land managers, the conservation community and the public did not know of the plants. There were management intentions to remedy the eroded tracks and to find out more about this species, but no funds were budgeted and it was not known that Stockyard Point in the Byfield Conservation Park was the core habitat for these two threatened species.

In 2009 I devised and ran a community NRM project funded by the Fitzroy Basin Association, which has resulted in these two species gaining a public profile, departmental budget allocations for rehabilitation and instilling some personal ownership and passion about the plants in the on-ground land managers. Managers have since done fire experiments and monitoring in 2010/11, nominated *Commersonia perkinsiana* as an endangered species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and are planning more monitoring before and after site rehabilitation in 2012.

While research and monitoring were the backbone of the project, community engagement was the priority. Land managers were engaged from the initial planning stage and the information sharing continued throughout the project. Posters and photographs about the plants and the community adventure of discovering more about 'our special endemic species' were produced early. They were important tools and were displayed at all appropriate venues during the year. Community volunteers were taken on all field trips and carried out data collection, searching and counting. As one of the main objectives was to inform the planning processes, comprehensive reports with recommendations for planners were written and maps produced for each species (Campbell 2009a&b).

When exploring the methodology for assessing plant populations suitable for this project a number of texts and the Queensland Herbarium were consulted. Methods used vary with the taxa and the distributional spread of a species and are limited by the resources available. Texts used for guidance include *Sampling Designs, Field Techniques and Analytical Methods for Systematic Plant Population*

Commersonia perkinsiana *was only known to the discoverer and the describer. It was not on any lists or plans and not known to the land managers where it occurred.*

Surveys (Keith 2000); *Plant Conservation: Approaches and Techniques from an Australian Perspective* (Brown et al. 2003); *Threatened plants – active bushcare* (Playford & Murray 2000); *Management of endangered plants* (Cropper 1993). The EPBC threatened species nomination form and the conservation advice statements and previous plant nominations found on the EPBC website were also useful to see what information was needed and what others were doing.

The aim of monitoring was to provide baseline demographic data for the two species and learn as much as we could about their ecology, constrained by the abilities of myself and the project participants, time budgets, permits, cyclones and the wet season.

Ecology

Six site visits were made 6 weeks apart where 5 permanent quadrats were monitored along with 20 tagged individuals of various levels of maturity. Data were recorded on numbers, size, growth, health, threats, flowering and fruiting. Habitat features were recorded such as vegetation structure, associated species, ground cover, soil, aspect, slope, drainage and altitude. From this it was possible to present observations with tables, graphs and photos and to hypothesise some ecological and lifecycle information for the species. This is now a baseline data set.

General observations were recorded and some specific investigations undertaken, for example a close inspection of 100 stems of *Commersonia perkinsiana* was done occasionally in the hope of finding some evidence of seed, as the capsules are unknown. Fire history was collected and mapped for the areas of occurrence. Individual plants of one species were mapped on a closed road where the closure date was known and recolonisation was observed. This provided a snapshot that can be repeated for comparison.

Population distribution

Habitat factors such as landform, soil, geology, vegetation structure, plant community, climate and elevation were analysed for the known specimen records. This was based on specimen label information, Queensland Regional Ecosystem mapping, geology and climate mapping and field inspections of the Stockyard Point area. Common features including proximity to nearest known population were listed.

Potential areas of occurrence, with matching habitat conditions were predicted, mapped and prioritised for further field survey. Many areas of potential habitat were searched. Participants surveyed areas totaling approximately 540 ha and reaching 150 km north and south of the known occurrences of the species. Methodology was for observers to walk through an identified potential habitat area approximately 20 m apart scanning the ground layer of vegetation 10 m to either side. Areas of predicted non-occurrence were also tested. The outside edges of each occurrence were mapped using GPS and GIS.

Land managers meet their special plants.

Population counts

To gain an estimate of the number of plants in the population a sample count was taken. It was considered problematic to attempt an actual count of even a small population. During monitoring of permanent quadrats, counting accurately required the tagging of each individual and then removing tags, which caused trampling damage to the vegetation. The sampling method reported to be most accurate for estimation of population density required random coordinates to be selected and then located on the ground across the population. We considered this to involve an unacceptable amount of trampling. The method we used was to sample along a randomly located transect across a number of the subpopulations which appeared to be carrying differing densities. Along each transect a count was taken within a 1 m^2 quadrat placed alternately to the left or right of the transect line random distances apart (from 0 to 5 m, sourced from a random number chart). Transects were continued until the edge of the population was reached and repeated until the mean density per square metre leveled out. Actual counts were done only where isolated small patches were found during the population mapping surveys. Results were extrapolated using the mapping we had prepared for the area of occupancy.

Conclusion

All stakeholders are finding the outputs useful and there is evidence that all intended outcomes of the project have been fulfilled. This project has enhanced plant conservation in our region and I encourage anybody to have a go at driving some sort of monitoring project and build your community stewardship of your local rare and threatened endemics.

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Monitoring remnant native grassland at St. Lukes Cemetery, Bothwell, Tasmania

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Introduction

St. Lukes Cemetery, a 1.4 hectare site established in 1827 and still in use today, is located in the midlands township of Bothwell, in the South East Bioregion of Tasmania. The cemetery is home to a small remnant patch of lowland native grassland, specifically Lowland Grassland Complex (Harris & Kitchener 2005) dominated by Kangaroo Grass (*Themeda triandra*) and Wallaby Grass (*Rytidosperma caespitosum)*. Lowland native grassland is regarded as the most depleted vegetation formation in Tasmania with more than 95% lost since European settlement. This ecological community is listed as critically endangered under the Commonwealth *Environment and Protection Biodiversity Conservation Act 1999*.

St. Lukes, in common with a few other cemeteries/ churchyards scattered throughout the Tasmanian midlands, is a place of outstanding conservation significance that provides a refuge for a number of rare and threatened grassland species (Kirkpatrick et al. 1988). Around 45 native species have been identified in the cemetery, five of which are listed as rare and threatened. The cemetery is environmentally significant for having one of only three surviving Tasmanian populations of Lanky Buttons (*Leptorhynchos elongatus*), a 30 cm tall perennial herb that produces yellow daisy flowers from October through to December. The species is listed as endangered under the Tasmanian *Threatened Species Protection Act 1995*.

Site management history

A detailed study of Tasmania's grasslands carried out during the 1980's resulted in the rediscovery of Lanky Buttons (a species not seen in Tasmania for over a century) at St. Lukes cemetery. At this time management of the site was minimal, comprising occasional mowing carried out during the spring/summer period. At some point thereafter the site manager (Central Highlands Council), in accordance with the community's desire to keep the cemetery neat, adopted a regular, intensive mowing regime that resulted in vegetation being cut very short throughout the year. Had this practice continued, it is highly probable that over time a point would have been reached when the population of Lanky Buttons and other native species could not be sustained and would possibly become locally extinct.

In 2002, Greening Australia produced a management plan for the site (Leonard, 2002) with the primary objective to recover the population of Lanky Buttons. Key to achieving this end was the adoption of recommended alterations to the mowing regime in the older part of the cemetery where the remnant is located. The plan stated that a no-mow period be applied from September through to mid December to allow Lanky Buttons and other native species adequate time to actively grow, flower and set seed.

St. Lukes Cemetery Committee encouraged Council to adopt Greening Australia's prescribed mowing actions in 2005. In 2006, funds made available through the Biodiversity Hotspot Project were granted to Council to employ a consultant to (in addition to other actions) undertake annual monitoring of Lanky Buttons and other threatened species in the cemetery. Council demonstrated a long term commitment to preserving the site's natural values through the signing of a Vegetation Management Agreement in August 2007.

Scope of Royal Tasmanian Botanical Gardens involvement

Council engaged the services of the Royal Tasmanian Botanical Gardens (RTBG) as the preferred consultant to assist with implementation of management prescriptions and actions outlined in the Vegetation Management Agreement over a 5 year period, commencing in 2008. Our work in the cemetery to date includes:

- monitoring conducted annually;
- provision of a maintenance guidelines document;
- training of Council field staff in identification of weeds/ threatened species and site management requirements;
- provision of signage explaining why altered management practices have been adopted;
- collection of herbarium specimens with a view to compiling two comprehensive collections for Council (as an identification resource) and the RTBG;
- long term banking of *Leptorhynchos elongatus* seed as part of the Tasmanian Seed Safe Project;
- surveying of vegetation.

What is the RTBG approach to monitoring in the Cemetery?

Monitoring is considered a key action in the primary endeavour to recover and increase the population of Lanky Buttons and other threatened species in the cemetery.

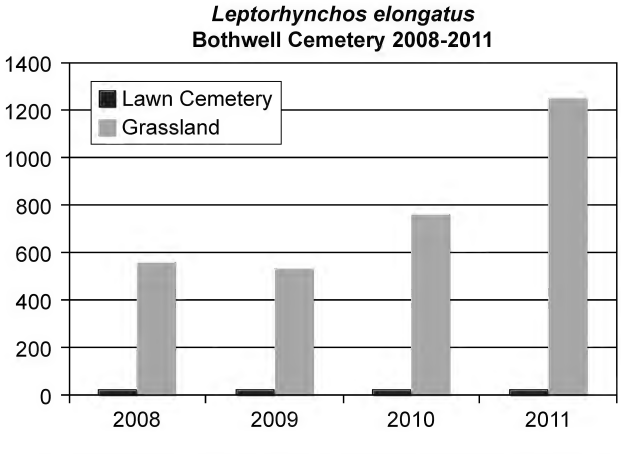
Our monitoring programme employs the use of two monitoring methods and is being conducted annually over the contracted five year time frame. We considered

five years to be the minimum period necessary to glean meaningful data, allowing for factors such as seasonal variability and the impact of recent management actions.

Method 1: Sampling with quadrats

We employed this method to accurately determine vegetation composition and abundance over time. Our aim is to track any change in the number of native and introduced species in each management unit and if necessary convert findings into actions through modification of prescribed management practices. Four quadrats measuring one square metre, and subdivided into 100 x 10 cm^2 squares are positioned on exactly the same spot each year with specific grave sites used as reference points to ensure easy, accurate positioning of quadrats. Three quadrat sites are located in the remnant with the fourth in the regularly mown area where a relatively small patch of Lanky Buttons is found. Plants within each 10 cm^2 section are identified and density estimated and to simplify analysis some of the individual species are grouped together (e.g. exotic grasses, exotic dicots). Determination of the size and number of quadrats was dictated by vegetation type, remnant area and available resources (staff time and funding).

*Lanky Buttons, (*Leptorhynchos elongatus*) growing in lowland native grassland at St. Lukes Cemetery. Photo: Natalie Tapson*



The number of Lanky Buttons has remained unchanged in the regularly mown section of the cemetery over the 4 year monitoring period, while numbers have more than doubled in the grassland section.

Method 2: Annual Lanky Button population census

This relatively straightforward method involves a walk-through count of plants at all stages of growth to determine, within reasonable accuracy, the total number of Lanky Button individuals and the extent of the population in the cemetery. This is a quick and easy task in the newer regularly mown section of the cemetery which contains relatively few (approximately 20) plants. To facilitate methodical counting of individuals in the older section of St. Lukes we divided the area into 25 x 5 m strips using tent pegs and stringlines. The count is carried out each October when plants are easy to see, before excessive growth makes it difficult to detect small specimens. Population size and distribution of other threatened species within the remnant is also roughly estimated.

Monitoring outcomes

Data analysis of our field monitoring work reveals very encouraging results. Quadrat monitoring over a four year period (2008-2011) demonstrates minimal shift in the exotic/native species balance rendering alteration to current management practices, including implementation of weed control measures, unnecessary at this point. The census reveals that there has been a dramatic increase in the number of individuals since implementation of management prescriptions from around 200 specimens in 2005 to a total in excess of 1200 in 2011. This clearly demonstrates that high rates of natural recruitment can occur when Lanky Buttons is given the opportunity to flower and set seed. This is the logical conclusion given that the number of specimens in the regularly mown area of the cemetery has remained relatively stable at around 20 plants.

Concluding comments

Vegetation monitoring in St Lukes is a key and fundamentally important action that is enabling informed decision making to help ensure Lanky Buttons and other threatened species in St Lukes Cemetery have a secure refuge for many years to come. Our monitoring results reveal what can be achieved when conservation organisations such as Greening Australia and the Royal Tasmanian Botanical Gardens work in partnership with a committed land manager who engages in the sensitive management of a botanically significant site.

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Topsoil translocation: an effective method for increasing plant species diversity in restored sites

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Introduction

The establishment of a characteristic assemblage of native species is fundamental to the restoration of natural ecosystems. Species diversity is important in aesthetic terms (restored sites must resemble reference sites) and because restored ecosystems are more likely to be functional, self-sustaining and resilient in the face of periodic environmental perturbations if they contain the full range of species growth-forms, and regeneration and nutrient acquisition guilds.

While there is considerable debate concerning how reference sites should be selected and how restoration outcomes should be assessed, practitioners face the immediate practical problem of sourcing the large range of species required to establish diverse ecosystems. Topsoil translocation has emerged as a partial solution to this problem. Topsoil typically contains a range of plant propagules, populations of invertebrates, soil microbes and mycorrhizae typical of an ecosystem. If a suitable donor site is available then these organisms can be effectively translocated by transferring the topsoil to the site at which the same ecosystem is to be restored.

In the Jarrah forest of south-western Australia, translocation of topsoil from native vegetation cleared for strip-mining is integral to the restoration of rehabilitated pits following bauxite extraction (Koch 2007). Research sponsored by Alcoa World Alumina Australia has made a significant contribution to increasing the establishment of native plant species following topsoil translocation.

Techniques employed by Alcoa vary in the level of expense, specialised machinery and infrastructure required. For example, simple protocols developed for the stripping, storage and return of topsoil can markedly improve the survival of microbial organisms and establishment of plant species following restoration. These protocols may be employed using machinery operating at a typical construction site. In contrast, specialised personnel and equipment are required to undertake procedures such as supplementary seed broadcasting, mimicry of fire-related germination cues and topsoil seedbank concentration on a large scale.

Our study aimed to determine whether topsoil translocation carried out according to simple handling protocols alone would yield tangible restoration benefits in grassy woodland communities in south-east Australia.

Restoration at the Hunter Economic Zone development

The Hunter Economic Zone development is located to the south of Kurri Kurri, approximately 150 km north of Sydney in the Hunter Valley, south-eastern Australia. The site comprises approximately 3200 ha of native vegetation including three ecological communities listed as endangered under the NSW *Threatened Species Conservation Act 1995* (Hogbin 2011).

Initial works involved the clearing of vegetation in corridors to accommodate infrastructure including roads, sewers, communications and energy utilities. Restoration of the road verges and utilities corridors was undertaken immediately using topsoil translocation in combination with supplementary planting and seeding of selected native species.

Topsoil stripping commenced with the removal of trees and slashing of shrubs and ground cover. Topsoil was stripped in horizontal sequences and stored on-site in uncovered windrows, as shown in the following table.

Topsoil layer	Nominal depth	Size of windrows
Bio-layer (slashed vegetative material, surface litter) and O-layer material	0–40 mm	1 m high x 3 m wide
A1 horizon	40–140 mm	1 m high x 3 m wide
A2 horizon	140–290 mm	3 m high x 5 m wide

The vegetation type and spatial provenance (original location ±150 m) of all stockpiles was recorded.

The replacement of topsoil on road verges and embankments was designed as an experiment to determine the effect of storage delay (0, 8, 10 or 13 months) and vegetation type (two different endangered ecological communities). Prior to reinstatement the subsoil was contoured and ripped (150 mm depth, 500 mm spacing, and parallel to contours). Topsoil layers were reinstated in their original order at the approximate location they were stripped from and spread using a mechanical rake operating from adjacent to the reinstatement zone. Surface heterogeneity was developed using a low cover of woody material partially incorporated in the topsoil.

We recorded the frequency of all native species establishing following restoration and compared these data with observations made prior to clearing.

Results

Most areas reinstated with topsoil developed a relatively sparse, but even, cover of native species dominated by grasses. Levels of native species richness and diversity were as high as in pre-clearing reference plots across all of our experimental treatments (Tozer et al. 2011). Eighty-one species (42%) were not detected in the reference plots and only emerged following topsoil translocation. Only 11 species failed to re-establish.

Although species diversity in restored sites was high, compositional resemblance to reference sites was low. For one ecological community, species composition in sites restored without delay was closer to reference sites than in those where restoration was delayed. It appears that compositional resemblance decreases with increasing delay in restoration, although the effect was not pronounced over our assessment period.

The response of individual species was related to fire-response attributes. Species with hard seeds requiring heat-stimulated germination (species of Fabaceae including *Acacia* spp) established in high numbers, perhaps because the solar heating of the bare topsoil over summer promoted germination. Most annual and perennial grass species increased in frequency following translocation, irrespective of any documented requirement for chemical or heat-stimulated germination associated with fire. These and other fast-maturing forbs were also able to produce seed during the time soil was stockpiled.

Species which declined following translocation included shrubs from families other than Fabaceae (e.g. Dilleniaceae, Epacridaceae and Euphorbiaceae) and rhizomatous, resprouting herbs (e.g. the genera *Lepidosperma* and *Lomandra*).

In general, resprouters and seeders with a long juvenile period and physiological, morphological or morpho-physiological dormancy mechanisms responded poorly to topsoil translocation and are likely to require supplementary planting. Resprouters and seeders with persistent seed banks, and either a short juvenile period or a physical seed dormancy mechanism, are least likely to decline and are lowest priority for supplementary planting.

Typical appearance of a restored road verge approximately six months following topsoil reinstatement. Photo: Mark Tozer.

Conclusions

We conclude that topsoil translocation can play a valuable role in restoring plant species diversity to degraded sites. Propagation and planting alone would not effectively replicate the range of species establishing at our sites, nor would the selection of species take into account species only resident in the soil seed bank. Conversely, sites restored by topsoil translocation alone are unlikely to resemble reference sites in the short term without supplementary seeding or planting, and the provision of appropriate germination cues. Restoring topsoil without delay is most likely to maximise the resemblance of restored and reference sites.

While topsoil stripping, storage and translocation as carried out in this study were accomplished using standard machinery we identified several potential logistical constraints in coordinating engineering and restoration requirements. First, direct return of topsoil requires that stripping and restoration are occurring simultaneously in different parts of the project. Inefficiencies resulting from this arrangement must be clearly identified and funded in advance to ensure the compliance of contractors. Second, the arrangement of topsoil in low, narrow, provenance-specific windrows requires considerably more space and planning than a typical engineering project to ensure that the correct topsoil is accessible for restoration when required. Finally, poor communication and supervision can result in outcomes that are completely inappropriate for the establishment of native species, thus negating the value of topsoil as a seed source. In our experience, poor spreading configuration, soil compaction, and excessive use of mulch resulted in very poor establishment of native species.

Acknowledgements

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Adaptive monitoring of vegetation in the Macquarie Marshes, New South Wales

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Introduction

In 2005 a group of Macquarie Valley landholders formed the Macquarie Marshes Environmental Trust to purchase the 259 ha property 'Burrima' on the western side of the northern Macquarie Marshes. The property contains three distinct vegetation communities, each covering about a third of its area. The communities (from west to east) are:

- low chenopod (*Atriplex/Sclerolaena*) shrubland on cracking brown clays;
- Coolibah (*Eucalyptus coolabah*) open woodland with often dense Black Roly-poly (*Sclerolaena muricata*) understorey on cracking grey clays;
- River Red Gum (*Eucalyptus camaldulensis*) woodland on cracking grey clays.

After purchase the property was de-stocked, although it still contained some native and feral animals including kangaroos, emus and feral pigs. Its management regime became similar to that of the adjacent northern Macquarie Marshes Nature Reserve. The response of the vegetation to de-stocking has been monitored in an adaptive way, as outlined below.

Adaptive monitoring after de-stocking

Initial monitoring plots

Two 20 m x 50 m survey plots were established in each of the three vegetation communities on the property, to determine whether the removal of domestic stock leads to:

- an increase in overall floristic diversity, groundcover vegetation and perennial species diversity;
- a decrease in exotic species diversity and cover, and annual species cover/abundance.

In July 2005 (just after de-stocking) full floristic descriptions were obtained for each plot. The cover and abundance of each species was then recorded at six monthly intervals until January 2009, and thereafter recorded each January. The plots were affected by a major flood in 2011.

Grazing exclosure plots

Early in the monitoring program it was noted that grass re-establishment was poor and most tussocks were grazed close to ground level, presumably by native and/or feral animals. To monitor the impact of this grazing and investigate additional methods of groundcover establishment, in August 2008 one vertebrate grazing exclosure plot was established in each of the three vegetation communities, each plot with the same grass establishment treatments.

Raking to remove *Sclerolaena* was carried out in the 'Raked' treatment area before fencing. Each grazing exclosure (fenced area) was 72 m x 72 m with a 1.4 m high Weston design fence constructed in a way to prevent animals digging underneath or climbing through it.

Grass seeds were hand sown throughout each exclosure and in the adjacent unfenced areas, using seeds of Queensland Bluegrass (*Dichanthium sericeum*), Curly Mitchell Grass (*Astrebla lappacea*) and Warrego Summer Grass (*Paspalidium jubiflorum*).

Five randomly located 1 m^2 plots were measured in each of the four treatment areas in each community. All vegetation was identified in each plot, the number and percentage cover of each species recorded, and the percentage cover of litter, bare earth and cryptogams recorded. Grazing levels outside the exclosures were monitored indirectly by faecal pellet counts. An initial survey was conducted in December 2008 to obtain a dataset as close as possible to the time of fence construction, then monitoring was repeated annually during spring.

Monitoring in the grazing exclosure plots and adjacent treatment areas aimed to:

- determine the impact of total vertebrate grazing pressure on natural grass establishment and the establishment of sown native grass species;
- investigate the impact of protection from vertebrate grazing on the cover and/or abundance of other groundcover species;
- investigate whether initial removal of the most abundant groundcover would aid native grass establishment.

Results to date

Initial monitoring plots (July 2005–January 2011)

The total number of species recorded from all transects increased from 57 to 72 over the six year period. Coolibah woodland showed an increase from 31 to 34 species, while River Red Gum woodland showed a decrease from 34 to 31 species, mainly due to its transects being flooded and aquatic plant richness being lower than for terrestrial species.

The low chenopod shrubland species richness hardly changed during 2005–08, then reduced significantly in drought but recovered after good seasonal rains to record its highest richness on the last monitoring period in January 2011. Over the entire period its species richness increased from 21 to 37 species.

Vegetative groundcover decreased in all communities, but there was a corresponding increase in leaf litter accumulation (in the woodlands) and cryptogam cover (in the low chenopod shrubland). The total groundcover thus remained at similar levels over the survey period.

Perennial species diversity increased in two of the three vegetation communities, the greatest increase being in the low chenopod shrubland (which experienced the least flooding). The 2011 floods decreased the number of perennials in the Coolibah and River Red Gum plots, although monitoring to 2010 showed steady increases in perennials over the 2005 levels.

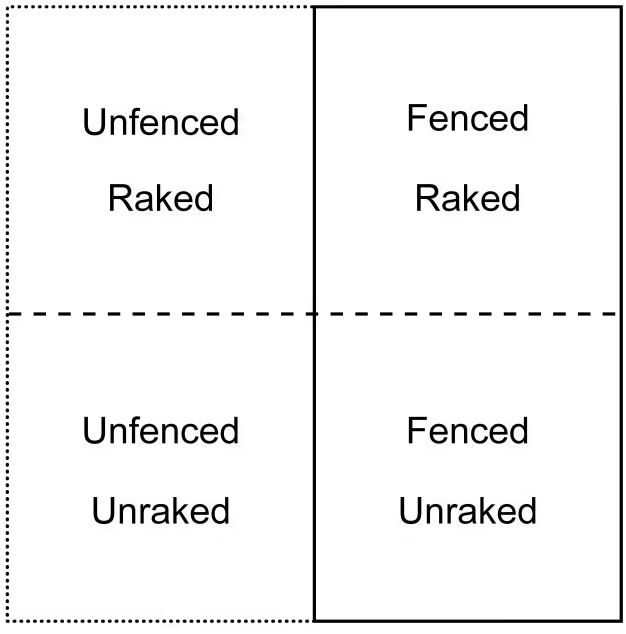
Only the River Red Gum woodland recorded a decrease in the number of exotic species over the survey period. However, the variation in exotic species diversity was only in the order of one species for each community. All three communities showed some annual species decreased in cover and/or abundance over the six year monitoring period.

Grazing exclusion plots (December 2008 to September 2011)

Grass species richness, cover and abundance were higher inside the grazing exclosures than outside. Grazing pressure outside the exclosures was so high the effect of raking on subsequent grass establishment could not be assessed. After 15 months and a high summer rainfall, all three sown grass species grew and seeded within the exclosures; none was recorded outside.

Raking reduced the cover of the herbaceous chenopods (*Sclerolaena* spp.) for 12–15 months only, after which it returned to around pre-raking levels in response to good summer rainfall.

Over the monitoring period there was a gradual decrease in the proportion of bare earth both within and outside the exclosures. On the scalded brown clay soils, litter and cryptogams tended to replace bare earth rather than vegetation, although vegetation cover increased on the grey clay soils. It seems that kangaroo grazing per se does not significantly affect changes in groundcover characteristics over time as similar trends occurred both within and outside the exclosures.



Exclosure plot design showing the four treatments. Bold line = fenced. Dotted line = unfenced. Dashed line = border between raked and unraked treatment. Unraked areas had an abundant groundcover of Sclerolaena *spp. In raked areas the* Sclerolaena *was removed by raking.*

Conclusions

The monitoring data have shown that after the removal of domestic stock, grazing by native animals such as kangaroos significantly reduces the recovery of native grasses and thus the replenishment of their soil seed banks.

With recent funding from the Central West Catchment Management Authority all vertebrate grazing animals (native and feral) will be excluded from nearly half of 'Burrima', allowing grasses and forbs to grow undisturbed for several years. Once the grasses are fully established the fencing will be removed to again allow kangaroo access. Their ongoing impact on the viability of grass species will be monitored. The results will have rehabilitation implications for marshland vegetation which typically retains high densities of kangaroos year round.

Acknowledgements

Thanks to Chris Hogendyk, Chairman Macquarie Marshes Environmental Trust, and all the committee members for allowing unrestricted access for monitoring and for encouraging all types of research and educational opportunities within the property.

Vegetation changes in unraked treatment outside Exclosure 3. (a) December 2008; (b) November 2009; (c) March 2010; (d) November 2010. Photos: Darren Shelly.

Measuring success in endangered species habitat management, the Brickpit, Sydney Olympic Park 2006-2011

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Monitoring is an essential tool for the successful restoration of degraded ecosystems. The challenge at The Brickpit, Sydney Olympic Park, formerly a weed-infested wasteland, is how to, remove all noxious and environmental weeds while retaining or enhancing habitat for a diverse range of fauna species, including threatened species. Regular monitoring and an adaptive management strategy are crucial to ensuring that vegetation management is improving, or at least retaining habitat values, and not having an adverse effect on the populations of key fauna species.

The Brickpit

The 27 ha Brickpit was formally the quarry of the State Brickworks. It now comprises a landscape of steep exposed slopes, shale and sandstone quarry pits, boulder, rubble and scree piles, naturally formed wetlands, ephemeral ponds, constructed ponds and a reservoir.

During the planning stages for the 2000 Sydney Olympic Games, it was discovered that the Brickpit provided an important breeding habitat for the endangered Green and

Golden Bell Frog (GGBF) *Litoria aurea*. This resulted in the Brickpit being left, for the most part, undeveloped during the Sydney Olympic Games. Between Brickpit operations ceasing in 1992 and the introduction of a vegetation maintenance program in 2001, noxious and environmental weeds became established in large areas across the Brickpit in both terrestrial and aquatic habitats. The most dominant weed species were *Lantana camara, Cortaderia* sp. (Pampas Grass) and *Juncus acutus*. Both *Cortaderia* sp. and *Juncus acutus* provide ideal breeding and foraging habitat for the GGBF, while *Lantana camara* provides protected breeding habitat for bush birds.

Between 2001 and 2006, vegetation management comprised mainly control of juvenile specimens of the dominant weed species, along with the removal/treatment of other noxious weeds such as *Chrysanthemoides monilifera* ssp. *monilifera, Rubus fruticosus* species aggregate, *Ligustrum* sp., and other environmental weeds. Mature specimens and stands of the dominant weeds species were retained, along with some environmental weeds such as *Eragrostis curvula* and *Cenchrus clandestinus* (previously known as *Pennisetum clandestinum*), for the habitat values they provided. Works were undertaken as per recommendations made by a herpetologist, and tended to be precautionary during periods when frog habitats were establishing and the results from monitoring of initial vegetation management activities were analysed. During this period, small-scale revegetation trials were undertaken to establish which species would tolerate the harsh conditions of the Brickpit environment, primarily the lack of developed soils.

In 2006, a program of long-term staged weed removal was initiated with the aim of removing the majority of dominant weeds by 2018. This program included habitat replacement with native species selected for a similar growth form to the removed weeds and resilient enough to survive the skeletal soils of the Brickpit. Each planting stage is required to form a functional habitat before further weed removal occurs to ensure no net loss of overall habitat.

The monitoring program

The GGBF and bush birds were identified as the priority species in the Brickpit and a monitoring program was devised to provide information about distribution and abundance to assess responses to actual and planned vegetation changes. Potential short-term impacts from vegetation removal may include changes to microclimates, increases in predation and decreases in resource availability. The monitoring program is necessarily long-term to provide enough time for replacement plants to mature in the developing soil and harsh conditions present in the Brickpit. A long-term monitoring program will also provide richer information for teasing out some of the seasonal, spatial and other variation in the use of habitats by the GGBF and bush birds.

Monitoring for species abundance and distribution has been undertaken annually in the Brickpit since 1996 for the GGBF and since 2003 for bush birds. Frog monitoring primarily involves the identification of the three breeding indicators, calling males, tadpoles and juvenile frogs. Other concurrent frog research projects and incidental surveys assist in understanding the frog's distribution and activity. Locations and vegetation type are also recorded and assist in planning future revegetation work. Bird monitoring involves 8 x 20 minute surveys of established quadrats in September-November and the collation of incidental sightings all year.

An annual review of habitat condition is undertaken in collaboration with a herpetologist using the monitoring data. Annual reports on both GGBF and bush bird status identify areas of breeding, foraging and refuge habitat. This information can then be used to indicate the level of success of past actions and assist in the planning of future activities. Incidental monitoring of the natural recruitment of previously planted species also feeds into the refinement of plans for future revegetation work.

The weed management program

From 2006, the staged removal of mature Lantana, Pampas Grass and *Juncus acutus* from large areas of the Brickpit was initiated. Suitable zones of the Brickpit are identified each year with the volume of vegetation removed being dependent on the success of previous plantings and the current distribution of target species as indicated by the monitoring program.

Timing of works and methods of treatment protocols are implemented to minimise potential harm to priority species. All works are conducted within the active season for the frogs (September-April) and outside the breeding season for bush birds (February-May).

Removed vegetation (excluding seed and vegetative propagules) is retained on site for various purposes including: providing organic matter to developing soils; retaining soil moisture; providing sheltering habitat; food source for priority species as vegetation decays; and to ensure no inadvertent removal of sheltering fauna.

Removed Pampas laid as mulch in the foreground, with maturing plants from previous revegetation activity behind. Photo: Sydney Olympic Park Authority

Outcomes

Over 30,000 plants have been installed in the Brickpit between 2006 and 2011 to replace approximately 1 ha of Lantana and 50% of the initial Pampas Grass and *Juncus acutus* populations. Overall, the program does not appear to have adversely affected the GGBF population with GGBF not varying greatly in distribution or abundance. Plantings in wetland habitats have expanded in size and volume and GGBF have been recorded calling and breeding in new habitat.

From early revegetation trials, installed terrestrial plants were not expected to provide adequate habitat for bush birds for a minimum of 3 years and in many cases required 4 or more years to mature, dependent on microclimate and other conditions. Bush birds are beginning to utilise habitats installed between 2003 and 2007 that replicate the height and depth of the original vegetation with breeding events recorded. More monitoring is required to fully understand the structural complexity required by the bush birds. Natural recruitment is occurring from planted specimens leading to the prospect of some self-sustaining plant communities and a reduction in future management costs.

Sydney Olympic Park's monitoring program provides important information on the ecology of target species, particularly species response to vegetation management within their habitat. This information provides direct input into an adaptive management program aimed at supporting future decisions.

Five year old plantings, now functioning as bird habitat, cluster at the base of the cliff replacing Lantana thickets. Supplementary plantings expand the cluster with surrounding exotic ground covers still functioning as habitat. Photo: Sydney Olympic Park Authority

Biodiversity Monitoring: Branching 'outside the Box' for Box-Gum Grassy Woodland

Mary Munro and Damian Michael

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Information being collected from forty monitoring sites in North East Victoria is contributing to a nationally significant grassy woodlands biodiversity monitoring program established by Professor David Lindenmayer and Dr Damian Michael from the Australian National University (ANU).

The sites were established as part of a $3 million Australian Government funded 'Caring for our Country' project known as Threatened Grassy Woodlands. The project partners are Victoria's North East and Goulburn Broken Catchment Management Authorities (CMAs), the NSW Murray CMA, the Victorian Departments of Sustainability & Environment (DSE) and Primary Industry (DPI), Trust for Nature, Nature Conservation Trust and the Australian National University.

Why the focus on Grassy Woodlands?

Threatened Grassy Woodlands are one of Australia's most poorly conserved ecosystems, yet they provide much of the seed used to revegetate farmland and other modified areas, protect stock, crops and pasture from heat, cold and wind and can provide high intensity, short duration grazing opportunities. Grassy Woodlands are also essential for the survival of rare and threatened species such as the Superb Parrot, Regent Honeyeater, Swift Parrot and Squirrel Gliders.

Project overview

Led by the North East Catchment Management Authority (CMA), the Threatened Grassy Woodlands project aims to reverse the decline of Commonwealth (EPBC Act) listed and critically endangered grassy woodlands and improve

the understanding and engagement of land managers in sustainable grassy woodland management.

Since 2009, private land managers together with project partners have been involved in on-ground works and awareness raising to help conserve and better manage more than 3,300 hectares of nationally significant White Box, Yellow Box, Blakely's Red Gum Woodland, Weeping Myall and Buloke Woodlands in north east Victoria and southern New South Wales. In addition, private landholders have worked with the ANU to develop a long term biodiversity baseline monitoring program.

Designing a long-term, local monitoring program

At the project's inception, the various Threatened Grassy Woodlands project partners met with ANU to develop a local long-term Woodland biodiversity monitoring program.

As the project involved land managers undertaking various management interventions to protect and enhance grassy woodlands on their land, the partners recognised the need to test fundamental assumptions about whether the funded interventions would result in:

- increased native species diversity
- reduction in biodiversity threats
- greater structural diversity
- improved connectivity and resilience.

Together, they drew on expertise and experience developed through the ANU's existing Woodland monitoring program, spanning eastern and south-eastern Australia, to design a local monitoring program.

The overarching aim was confirmed: establishing a long-term biodiversity monitoring program designed to measure effectiveness of project investment on improved biodiversity outcomes.

The cross-sectional, short-term component of the study spanned years one and two. The main aim was to compare patterns of faunal diversity and vegetation structure among management treatments and between vegetation types.

Establishing the monitoring sites

The project partners established 40 permanent monitoring sites in two threatened grassy woodland vegetation communities; Box Gum Grassy Woodland and Buloke Woodland.

Sites in each vegetation type were stratified by management type to contrast with funded investment sites.

The four treatments involved:

1. Short-term conversion sites - Strategically grazed sites which were placed under a recent (2010) CMA funded 10 year management agreement
2. Long-term conversion sites - Ungrazed or strategically grazed sites which have had stock exclusion for a minimum of five years, e.g. Trust for Nature covenants before 2005
3. Production sites - areas farmed under traditional conditions, e.g. set stocked
4. Reference sites - long-term ungrazed sites managed for biodiversity e.g. Parks Victoria and road side reserves.

Monitoring sought to test the hypothesis that species diversity is highest in reference sites and lowest in production sites, reflecting time since livestock grazing. Given the short time period between management intervention commencement and survey commencement, species diversity in short-term conversion sites and long-term conversion sites was expected to be intermediate.

Testing assumptions

Ecologists from the ANU conducted two reptile surveys (winter and summer), two bird surveys (winter and spring) and two arboreal marsupial surveys (spring and autumn) during May 2010 and June 2011. They also measured a broad range of vegetation structural attributes in May 2010 and 2011 to establish baseline data on vegetation condition and floristic diversity.

Each monitoring site included artificial refuges (railway sleepers, roofing tiles and sheets of corrugated iron secured down by rocks) with varying thermal qualities to survey reptiles. On public land monitoring sites, a permanent post was established with a sign showing that the area is part of a long-term biodiversity monitoring site for the CMA.

Damian Michael and Mary Munro lift strategically placed roofing tiles to survey reptile presence in Grassy Woodlands in Barnawartha Scenic Reserve, one of forty monitoring sites in north east Victoria. Photo: Simon Dallinger

Observations

The cross-sectional study has so far recorded 17 reptile species, 2 terrestrial mammal species, 5 arboreal marsupial species and over 150 bird species, including several threatened species listed under the Victorian *Flora and Fauna Guarantee Act 1988*.

In the case of reptiles, ANU found statistically significant differences in species richness between vegetation types (highest diversity in Box-Gum Grassy Woodland) but not among management treatments. With arboreal marsupials there were statistically significant differences in species richness between treatments (highest diversity in reference and short-term conversion sites in spring) but not between vegetation types, and with avifauna, there were statistically significant differences in species richness between vegetation types (highest diversity in Buloke woodland in winter) but not among treatments.

Although not statistically significant, the ANU found patterns of diversity in some taxa conformed to the original hypothesis. For example, reptile species richness increased in a gradient from production sites to short and long-term conversion sites and reference sites. However, in contrast, arboreal marsupial and avifaunal diversity was found to be highest in the strategically grazed short-term conversion sites and lowest in the production sites.

Preliminary insights

The ANU's preliminary data suggests that there are clear differences in levels of biodiversity between vegetation types and among treatments for some elements of the biota. Specifically, these findings suggest that investment sites funded under the Australian Government's 'Caring for our Country' project may prove effective in enhancing areas that support comparatively high species diversity.

Interesting fauna survey observations included:

- Burton's Snake Lizard near Barnawartha - a species that reaches its geographical limit in North East Victoria
- Dwyer's Snake east of Talgarno - representing an easterly range extension in the Upper Murray region for this species
- Two Fat-tailed Dunnart sighting near Locksley in the Goulburn Broken catchment. This population is significant as few records exist for this species in this part of the Goulburn Broken catchment
- Sugar Gliders and Brush-tailed Phascogales
- Threatened Victorian bird species including the Australasian Bittern (Cullens Bushland Reserve), several families of the Hooded Robin (Dookie College, Talgarno and Locksley), a family of the Grey-crowned Babbler (near Longwood) and several populations of the Diamond Firetail.

Future directions for grassy woodland monitoring

The long-term phase of the study (longitudinal, from years three to ten) will investigate some fundamental questions, including whether funded investment sites increased native plant and animal species and vegetation structural diversity, reduced biodiversity threats and improved landscape connectivity and resilience.

These questions can only be answered once long-term data has been collected, requiring an ongoing partnership commitment to ensure funding long-term monitoring and research projects continue to be a priority.

Ongoing requirements include:

- ongoing commitment to fund long-term projects by CMAs and Federal Government;
- ANU to revisit 830 long-term sites every 2 years, including North East Victoria's 40 sites;
- developing studies to link patterns with processes;
- ANU communicating findings via scientific publications, books, workshops, field days, landholder presentations and print media.

The monitoring program has the potential to make a substantial contribution to grassy woodland conservation and biodiversity management in Australia by applying ongoing results in adaptive management programs. The data gathered will provide a baseline against which future biodiversity changes can be monitored.

Further information on the Threatened Grassy Woodlands Project and ANU's short-term biodiversity monitoring findings are online www.necma.vic.gov.au.

(left) Burton's Snake Lizard. (right) Fat-tailed Dunnart. Photos: Damian Michael

Australian Plant Census: November 2011 update

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The Australian Plant Census is a project aimed at providing an up-to-date list of currently accepted names for the Australian vascular flora, both native and introduced (see Australasian Plant Conservation 16(1): 20). In this article we describe progress since our last update (Lepschi and Monro 2009).

First pass almost complete

The first pass of the Census is nearing completion, with only a handful of families left to be treated for the initial phase of the project. Groups currently under consideration by the Australian Plant Census Working Group include some of the larger vascular plant families in the Australian flora. These include Apiaceae, Araliaceae, Cyperaceae, Ericaceae (in the broad sense, including Epacridaceae) and Fabaceae (Faboideae). In addition, compilation of the last two remaining untreated groups, Malvaceae (also in the broad sense, including Bombacaceae, Sterculiaceae and Tiliaceae) and Orchidaceae, is also well underway. Completion of these groups and presentation of final data via the Australian Plant Census web interface (www.chah.gov.au/apc/) is anticipated by May 2012.

Recently treated families

Other families recently treated for the Census include Asteraceae, Plantaginaceae (including Myoporaceae), Rubiaceae, Scrophulariaceae and Stylidiaceae. These groups are available as PDFs at <www.anbg.gov.au/chah/apc/families-treated.html>, and are currently being entered into the Census database.

Plant classification at family level and above

In addition to genus and species-level taxonomy, the Census has developed an agreed classification of Australian vascular plants at and above the level of family. This project was begun by Terri Weese in mid-2008, and completed by Meredith Cosgrove.

The work was prompted by recent changes in higher-level classification by various researchers around the world, in particular the Angiosperm Phylogeny Group (www.mobot.org/mobot/research/apweb/). The agreed classification largely follows the Angiosperm Phylogeny Group (2009) system but with some differences preferred by the Census Working Group. These include the recognition of Chenopodiaceae as a distinct family rather than part of an expanded Amaranthaceae.

This grass Austrodanthonia carphoides *is now called* Rytidosperma carphoides*. All other species of* Austrodanthonia *as well as species of* Joycea *and* Notodanthonia *have also been transferred to the genus* Rytidosperma*. Photo: M. Fagg.*

Other changes to familiar plant families in Australia include the sinking of Epacridaceae into an expanded Ericaceae, considerable recircumscription of Scrophulariaceae and related families (e.g. a much expanded Plantaginaceae, including Myoporaceae) and changes within the petaloid monocotyledon families (see also Purdie 2010). These changes and an overview of the Census process as a model for consensus-based taxonomic decision-making were presented in a poster displayed at the eighteenth International Botanical Congress held in Melbourne in July 2011.

Keeping the Census up-to-date

As completion of the first pass of the Census draws closer, the emphasis is shifting towards keeping information already entered up-to-date, in line with current taxonomic research. One such example is the recent revision of the danthonioid grasses by Linder et al. (2010), which has seen the transfer of all species of *Austrodanthonia, Joycea* and *Notodanthonia* to a broadly circumscribed genus *Rytidosperma*. A similar example is the sinking of the small Western Australian endemic gymnosperm genus *Actinostrobus* into *Callitris*, following Piggin and Bruhl (2010). These changes have been accepted by all major Australian herbaria, and are reflected in the Census.

The Census team in Canberra

The Australian Plant Census/Australian Plant Names Index (APNI) team reached its highest ever staffing levels this year, thanks to some funding from the Atlas of Living Australia. These additional staff boosted the outputs of the project in several areas. Gillian Towler, Phillip Kodela and Meredith Cosgrove have now finished their contracts with us. Gill undertook data entry for several Census lists, and added much additional data to APNI, while Phillip compiled several larger families for the Census and added many secondary references to APNI.

In addition to the higher-level taxonomy, Meredith compiled Census lists for a number of 'troublesome' families, including Orchidaceae. She has now moved on to work with the Australian Biological Resources Study on the Australian Faunal Directory. Meredith will also work part-time with the Integrated Botanical Information System (IBIS) team on improving the APNI and Australian Plant Census interfaces.

As always, the Census team welcomes feedback, queries and comments – you can contact us at Brendan.Lepschi@csiro.au and Anna.Monro@csiro.au.

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ANPC in the USA: directions in science and conservation at the Smithsonian Institution

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I am currently a visiting assistant professor at Sweet Briar College, Virginia, USA, having just completed a two-year postdoctoral fellow at the Smithsonian Environmental Research Center (the Center), Edgewater, Maryland, USA. This regular report covers some of my experiences in environmental research in the United States and provides recent highlights in science and conservation there. An introduction to this regular report and background on the Center can be found in issue 18(2) of *Australasian Plant Conservation* (September—November 2009).

Return to Oz

On New Years Day, 2012, I will be leaving my post here in the United States and heading back to the land downunder. It may be a little surreal to see Eucalypts and Kangaroos again, and since I've been driving on the right hand side of the road all this time, I recommend that all Canberrans avoid footpaths in February. Looking back on my experience of America, it was certainly more of a culture shock than I expected after a lifetime of imported television shows. The 'real' America is quite a different place from Carrie Bradshaw's New York City. Nobody understands what an 'arvo' is and that 'flat out like a lizard drinking' doesn't indicate an alcohol problem. Americans eat dill pickles with every meal and add peanut butter to everything. The inter-state diversity is incredible and even American-made television shows will provide subtitles so the rest of the country can understand what people from the Deep South are saying.

Americans love Aussies. They light up when you yell 'crikey!' and happily open their arms and doors to new friends. They are also impressively festive – creating theatrical home light shows for Christmas (that almost rival the theatrical Christmas attire), spooky displays for Halloween, and setting off massive backyard fireworks displays in neighbourhood competitions on Independence Day. In America, you can drive through the bank, at least twenty different chain restaurants, and even the pharmacy (though sadly not the bottle-o). There's some awesome wildlife, such as the pack of coyotes we heard from our

porch and the white skunk we saw by the driveway. I'm disappointed that I didn't get to see a bear so I may need to visit again. I will miss America but am really looking forward to returning to Oz and starting my position as secretary with the ANPC!

Science and conservation highlights

Can positive psychology improve conservation efforts?

Swaisgood and Sheppard (2010) discuss the culture of hopelessness among conservation biologists, recommending a more positive outlook to increase motivation for conservation action among scientists and the general public. Balancing pessimism with hope may be essential for driving our effort at mitigating environmental decline.

Global Strategy for Microbial Conservation

Only 2% of papers in conservation journals mention microbes, and most of these focus on their impacts on larger animals (Griffith 2011). Microbes play key roles in ecosystems, particularly in relation to decomposition and nutrient cycling. The entire community depends on these processes for available nutrients. Understanding microbial ecology, even in relatively unproductive habitats such as deserts and glaciers, could enhance the conservation of whole ecosystems.

Small forest fragments retain function in Kenya

Forest fragmentation is generally thought to isolate populations and drive local species extinctions, consequentially disrupting ecological processes. In a ten year study of the highly biodiverse Kakamega rainforest in Western Kenya, Schleuning et al. (2011) showed that fragmentation and selective logging did not affect overall functionality of these forests. Ecosystem functions such as decomposition, pollination and seed dispersal remained relatively stable, showing the value of protecting isolated rainforest fragments in addition to larger, intact forests.

Air pollution is fertilizing tropical forests

Increased emissions of atmospheric nitrogen dioxide as a result of human activities have altered the nitrogen cycle in tropical forests. Hietz et al. (2011) showed a substantial increase in nitrogen concentrations and the proportion of heavy to light nitrogen isotopes in leaves collected between 1968 and 2007. Increased nitrogen in tropical forests could influence the plant community composition by reducing the diversity of leguminous species because association with nitrogen-fixing bacteria will no longer provide a competitive advantage. While increased nitrogen deposition is predicted to enhance plant growth and thus increase sequestration of atmospheric carbon, there is currently no evidence that trees are growing faster (Hietz et al. 2011).

Are alien species all that bad?

Species that colonise regions outside their native range, often transported by anthropogenic vectors, are generally considered to be harmful in their new environments. However, not all non-native species become invasive; in some habitats they may even provide benefits such as increasing local biodiversity and mitigating environmental degradation. Davis et al. (2011) advocate shifting priorities from utilizing extensive resources in failed eradication programs toward determining whether non-native species are beneficial or negative in an ecological and economic sense. Extensive discussion prompted by this article highlights the current importance of this issue in ecology and conservation.

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Report from New Zealand Plant Conservation Network

Kerry Gillbanks

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Annual Plant Conservation Network Awards

Every year the Network asks for nominations for the Annual Plant Conservation Network Awards. The awards are to acknowledge outstanding contributions to native plant conservation. Our AGM was held on 11 November and the recipients of these awards were announced. Plenty of nominations were received for the six categories. The winners were:

- Anne Fraser, an orchid enthusiast, received the Individual award. In her late 60's she developed an interest in the Nationally Critical Spiral Sun Orchid (*Thelymitra matthewsii*). Her work is the most detailed and comprehensive study ever done on any orchid species in New Zealand.
- Southland Community Nursery at Otatira received the Plant Nursery award for its unique approach to the growth, preservation and education of the public about native plant species.
- Wanganui Intermediate School received the School Plant Conservation award for being involved in revegetation of the Gordon Park Scenic Reserve just outside of Wanganui. The Reserve is on the river floodplain and is one of the last remnants of its kind of swamp forest.
- Motuihe Trust received the Community Group award. Motuihe is an island located in the Hauraki Gulf, Auckland. The Trust has been involved with the islands ecological restoration since 2000. 337,308 plants produced from their nursery have been planted since 2003.
- The Greater Wellington Regional Council received the Local Authority award. Since the mid 1990's they have been committed to pest animal and plant control and monitoring of indigenous plant communities.
- Cory Meister, aged 17, received the Young Conservationist award. He started out as a 9 year old doing weekend work and assisting with working bees, and is now doing work experience and volunteering at 2 nurseries.

A lifetime achievement award went to John Smith-Dodsworth for his contribution to conservation over the last 30 years. Over the past 10 years he has been an important member of the Plant Network with setting up the Network website and providing many of the plant images.

Website/Network Updates

In October the Network launched an on-line 'Make your own plant book'. Users select plant information and images from the website, then have the option of being able to select their own cover and choose a species to feature on it, write their own title and either write their own introduction or select a pre-written one giving it the personal touch. The website holds information about all New Zealand plants with more than 23,000 images and 6,500 species pages. Happy book making.

The Network is now on twitter so you can follow us to keep up to date with plant conservation stories. Follow us @NZPlant.

Visit www.nzpcn.org.nz for more information.

Book Reviews

Wetland Weeds – Causes, Cures and Compromises

Nick Romanowski

CSIRO Publishing, September 2011, 184 pages pages with Colour photographs

Paperback ISBN: 9780643103955, AU $49.95

Wetland Weeds is a desk top companion for the wetland manager, student or enthusiast. Aquatic weeds, from the severely invasive to those that are simply present in wetlands, are described in terms of their origins, uses, preferred growth conditions, similar species, environmental effects, control and management.

Wetland Weeds is a plain English review of the current state and the potential of a range of wetland weeds. Each entry sets in context: where the plant has come from, what conditions favour it and how worried a land manager should be about it. Compiled from personal experience, the book brings together a set of expert observations on over

Book Reviews (cont.)

130 species. Wetland Weeds is neither a field guide nor a control manual, but provides what feels like a second opinion on the behaviour of wetland plant species.

Author Nick Romanowski is a biologist and water-plant expert with a very practical bent. He has grown water plants commercially and has a working knowledge of permaculture and habitat management. Romanowski is also a prolific writer on the topic of aquatic habitats with other titles including: Sustainable Freshwater Aquaculture and Planting Wetlands and Dams. Wetland Weeds will appeal to those managing land for conservation or production.

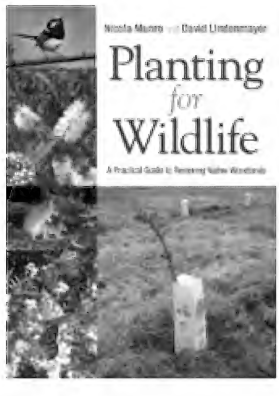
The sub-title causes, cures and compromises is an apt summary of the wetland manager's dilemma. There is no simple solution to the control of many of the listed aquatic weeds. In the cases of difficult to control species, there are the options to contain, tolerate, harvest, or even eat the weeds! For land managers fortunate enough to have a wetland which does not have invasive weed species, there are some very welcome recommendations for species that can be planted to preclude establishment of potentially troublesome weed species.

Overall: a great book to ponder when brushing up on the state of aquatic weeds in Australia, as a second opinion when your current weed control method is not working, or a must read prior to planning a created wetland.

Review by Liza Schaeper
IRPEC Pty Ltd

Planting for Wildlife – a Practical Guide to Restoring Native Woodlands

Nicola Munro and David Lindenmayer, Australian National University
CSIRO Publishing, August 2011, 96 pages with Colour photographs
Paperback ISBN: 9780643103122, AU $39.95



With the recent passing of the Carbon Tax and Carbon Farming Initiative through both houses of Federal Parliament, it is encouraging (and perhaps sobering) to see a flag raised for the art (and science) of restoring south-east Australia's temperate woodlands. Structured around straight forward notions like: why, where and how to revegetate, the guide's clear strength is its succinct translation of ecosystem science for lay consumption. Each section conveys simply the complexity of the revegetation project by educating in the principles of ecosystem function and summarising some of the latest applied research.

The pitfalls of attempting to balance multiple objectives for revegetation is only mentioned in passing. For example, trading-off biodiversity conservation for sequestering carbon in the interests of cost saving and expediency, is a significant risk. Given the title of the book, some specific guidance around how these trade-offs are identified and resolved would have been useful. It is important to underline that plantings for carbon, windbreaks, stock shade, salinity and timber etc. do not automatically make good quality or enduring wildlife habitat.

Although the scope of the book is broad, the authors clearly nail their colours to the mast as advocates for wildlife by concluding that, 'ecosystem restoration planting' is better at achieving multiple outcomes (that is best for wildlife) than traditional woodlots. The systems approach taken throughout the guide, constantly remind the reader of this fundamental point, and that even if the up-front costs can be higher, the longer term financial and ecological pay-off is worthwhile. Indeed this issue is central to the great challenge of sustainability. So, finding ways of minimizing the initial impost is a pragmatic reality that the guide encourages by assisting natural recovery processes. Strategies such as broadening roadside corridors by fencing-off adjoining paddock margins to allow natural regeneration, the use of direct seeding and many others aiming to mimic the natural environment are outlined.

While is fair to say there is currently no practical guide on revegetation of temperate south-east Australian woodlands as a whole, there are numerous excellent guides for woodland dominated sub-regions. The South West Slopes Revegetation Guide edited by Fleur Stelling (1998) and Revegetation Guide for the Goulburn Broken Catchment edited by Gill Earl et al. (2001) – both indispensable 'tools of trade' for local revegetation practitioners - are just two examples. With these as benchmarks for the industry, it may have been somewhat ambitious to attempt to produce a guide that is both "short and pithy" as well as being of practical relevance for woodlands from Tasmania, Victoria and South Australia, through NSW to south-east Queensland.

Perhaps one of the most important parts of the guide is left to last with a brief discussion of how plantings change

Book Reviews (cont.)

over time. Drawn largely from observations of established plantings, it paints an inspiring picture of what can be achieved as well as the commitment required, including the process of gradual improvement informed by long term observations and care.

Being well illustrated with a range of carefully selected photographs and diagrams, short and written in simple jargon-free language, the guide is an excellent introduction for those new to the business of revegetation and tree planting. Even though it would also be a useful read for those more experienced, it lacks the depth and detail that many practioners will need to source from local references, and it's only a pity these aren't available for all catchments throughout the realm of the temperate woodlands.

Review by Paul Foreman
Bush Heritage Australia and Blue Devil Consulting, Central Victoria

Information Resources and Useful Websites

The Weeds News

http://invasivespecies.org.au/traction

The Weeds News is a regularly produced summary of weed research, relating to control and/or prevention, in scientific and other relevant publications. It is compiled through The Weed's Network, a body that aims to help stakeholders in natural resource management learn more about invasive plants and weed control systems. You can have a weekly digest of weed research delivered direct to your email address by contacting <david.low@monash.edu>.

Atlas of NSW Wildlife

http://www.bionet.nsw.gov.au/

A new website for the Atlas of NSW Wildlife (Atlas) was launched in November 2011. The new website replaces both the old Atlas website and the old BioNet website, as a system for accessing government-held locational information for flora and fauna in NSW. The new website provides:

- improved search and mapping functionality;
- the ability to download the recordset returned by your search (downloads capped at 200,000 records) as a tab-delimited text file;
- the ability to search on the NSW Office of Enmvironment and Heritage's VIS Flora survey ('YETI') database module.

Phase 2 of the Atlas redevelopment is scheduled for completion in February 2012 and will allow users to:

- download data (up to 200,000 records) that are only available to licensed clients, including sighting and location notes, and more accurate geographic coordinates for sensitive species than are available in the public view of the data;
- upload your own spreadsheets of Atlas sightings (for example to fulfil scientific licensing requirements);
- access and, if authorised, to enter data into both the VIS Flora survey module and the Fauna survey module.

Saving a Million Species - Extinction Risk from Climate Change

Lee Hannah
Island Press USA, January 2012, 408 pages
Paperback ISBN 9781597265706 –AU $49.95

The research paper 'Extinction Risk from Climate Change' published in the journal Nature in 2004 created front-page headlines around the world. The notion that climate change could drive more than a million species to extinction captured both the popular imagination and the attention of policy-makers, and provoked an unprecedented round of scientific critique.

Saving a Million Species reconsiders the central question of that paper: How many species may perish as a result of climate change and associated threats? Leaders from a range of disciplines synthesise the literature, refine the original estimates, and elaborate the conservation and policy implications.

Saving a Million Species offers a clear explanation of the science behind the headline-grabbing estimates for conservationists, researchers, teachers, students, and policy-makers. It is a critical resource for helping those working to conserve biodiversity take on the rapidly advancing and evolving global stressor of climate change – the most important issue in conservation biology today, and the one for which we are least prepared.

Information Resources and Useful Websites (cont.)

Plants of Capricornia

Melzer, Rhonda and Joel Plumb
Rockhampton: Capricorn Conservation Council, (2011 reprint with updates), Hardcover, 588 pages, colour photographs, map. AU$160.00

This book fills a gap in available plant recognition and identification guides for Queensland - that of central coastal Queensland. The book uses the area defined as Capricornia to introduce the reader to a rich diversity of landscapes, vegetation communities and plant species. For those unfamiliar with botanical literature it is a "user-friendly" introduction to the language and concepts of plant taxonomy and classification including the meaning of scientific names and how to pronounce them. It is also an invaluable resource describing and illustrating more that 600 native species including trees, shrubs, mistletoes, and herbaceous plants. Fifty weed species are described and photographed. Information is also provided on the timber, fibre, medicinal, food and horticultural uses of the plant species, and their ecological values including their use by mammals, birds and insects. Available from http://www.cccqld.org.au/book.html

Encyclopedia of tropical plants: identification and cultivation of over 3000 tropical plants

Fayaz, Ahmed
UNSW Press, August 2011, 720 pp., colour photographs
Hardcover ISBN 9781742232904. AU$85.00

This is the most comprehensive volume on tropical plants available. Over 3000 species from all the major plant groups of the tropics are included accompanied by over 3000 colour photographs that help to illustrate the major features of these plants. Botanists, tropical plant enthusiasts and collectors, landscape designers and gardeners will all find this superb reference an invaluable guide to the world's tropical flora

Available from http://www.newsouthbooks.com.au/isbn/9781742232904.htm.

Research Roundup

Compiled by Kirsten Cowley, Centre for Plant Biodiversity Research, Canberra.
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Research Roundup (cont.)

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Conferences and Workshops

Fungi Festival 2012

26-30 April 2012
Hobart, Tasmania

Fungi Festival 2012 includes a Symposium on the Conservation and Management of Fungi (April 26-27) and weekend workshops and forays about fungi as well as a debate on the 'Eating wild fungi: fun or foolhardy'. Fungi Festival 2012 is organised by Fungimap and NRM South (Tasmania).

Further information: Blanche Higgins (Fungimap Coordinator) 03 9252 2374, fungimap@rbg.vic.gov.au. Booking forms will be available on the Fungimap website in January 2012, http://www.rbg.vic.gov.au/fungimap

Conserving Plant Biodiversity in a Changing World: A View from NW North America

13-14 March 2012
University of Washington Botanic Gardens, Seattle, USA

We face an uncertain future - economically, politically, and climatically. Those concerned with managing, researching or protecting native plant communities, rare plants and their habitats need to be aware of these changes and have the necessary tools to effectively address them. The aim of this conference is to engage all in a dialogue intended to raise questions and find solutions. For more information visit http://depts.washington.edu/uwbg/research/plant-biodiversity-2012.shtml

Conferences and Workshops (cont.)

2012 National Wetlands Symposium

21-23 March 2012
Invercargill, New Zealand

The National Wetlands Symposium is a bi-annual event run by National Wetland Trust. The trust is a non-profit organisation that aims to:

- increase public knowledge and appreciation of wetland values;
- increase understanding of wetland functions and processes;
- ensure landowners and government agencies commit to wetland protection, enhancement and restoration.

For more information go to
http://www.wetlandtrust.org.nz/symposia.html

2nd National Conference on Practical Responses to Climate Change

1-3 May 2012
Canberra, ACT

The theme for 2012 is "Water and climate: policy implementation challenges". This conference will be an opportunity for policy makers, engineers, scientists, planners and academics to present, hear and debate the latest research and practice on water and climate policy implementation challenges in urban, catchment and coastal environments. Visit the conference website at www.climatechange2012.org for further information regarding conference themes.

19th Australian Orchid Council Conference and Show

11 – 16 September 2012
Perth, WA

The Australian Orchid Conference, held every three years, will be held in Perth this year. For more information visit http://www.waorchids.iinet.net.au/19th_AOC_Conference.htm

Australasian Systematic Botany Society Conference

23-26 September 2012
Perth, WA

The Australasian Systematic Botany Society conference will be hosted by Kevin Thiele and the Western Australian Herbarium. For more information visit the ASBS website http://www.anbg.gov.au/asbs/index.html

Australian Rangeland Society 7th Biennial Conference

23-27 September 2012
Kununurra, WA

This conference brings together managers, users and researchers of rangelands for discussion of 'hot topics' and current rangeland issues. The conference will feature the latest research and development and the synthesis and application of knowledge.

The theme for the Conference is 'celebrating diversity: people, places, purpose'.

For more information visit http://www.austrangesoc.com.au/site/whatson_conference.php

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Sydney Olympic Park Authority, NSW

University of Melbourne, Burnley Campus, VIC

Australian Network for Plant Conservation Inc (ANPC)

9TH NATIONAL CONFERENCE

In partnership with the
Australian National Botanic Gardens
21 years collaborating for conservation

AUSTRALIAN NATIONAL BOTANIC GARDENS

Plant Conservation in Australia: Achievements and Future Directions

Celebrating the ANPC's 21st year, the conference will:

- review and highlight achievements over the last two decades;
- evaluate the strengths and weaknesses of existing approaches;
- highlight current major issues;
- identify directions for the coming decades.

Monday 29 October to Friday 2 November 2012
Canberra ACT

To keep informed about the conference subscribe to ANPC News – go to our website www.anpc.asn.au

Photos (top to bottom): *Dendrobium phalaenopsis; Anigozanthos manglesii; Epacris impressa; Telopea speciosissima; Eucalyptus globulus; Gossypium sturtianum; Wahlenbergia gloriosa; Swainsona formosa*. Photos: APII M.Fagg